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Air Combat

A-4 Skyhawk in the Falklands

Although it was the Argentine navy's Super Etendards which the Royal Navy feared most – and with good reason, due to their Exocet capability – it was not this aircraft, or the supersonic Dagger/Mirage, which caused the most damage to the British Task Force dispatched south to retake the Falklands. Instead, that honour went to an obsolete and poorly equipped light attack aircraft designed for carrier operations, but which was forced to make its attacks from land bases at the extremes of its range capability.

On the eve of the Falklands War, approximately 36 A-4Bs and 16 A-4Cs were on the FAA (Fuerza Aérea Argentina) active inventory listings, although not all were operationally capable. On 14 April and 1 May 1982, Grupo 5 de Caza deployed to Base Aérea Militar Rio Gallegos in the southern Santa Cruz province, activating the temporary I and II Escuadrones de Ataque, each with a strength of 11 A-4Bs. Grupo 4 de Caza deployed nine A-4Cs to San Julian air base in the same province, forming the Escuadrón de Ataque A-4C, and these units became part of the recently activated Fuerza Aérea del Sur (Southern Air Force) command (CdoFAS). Attrition replacements or aircraft in need of overhauls were flown from/to their respective peacetime bases, where a nucleus of pilots remained, usually the less experienced ones.

Curiously enough, those A-4Bs equipped with poorer avionics were the most successful anti-ship strike aircraft in the Argentine inventory, more so than the Exocet-equipped Super Etendards. Among their kills were the ships HMS *Ardent*, *Antelope*, *Coventry*, and the RFA *Sir Galahad*, plus many others damaged; but the price paid was very high in terms of aircraft and pilots. The A-4Bs performed 133 operational missions, engaging in combat in 86, and lost 10 aircraft and nine pilots. The A-4Cs recorded 86 operational missions, engaging in combat in 41, and lost nine aircraft and eight pilots.

At the start of the Falklands/Malvinas war, the Argentine navy's Skyhawks put to sea aboard *25 de Mayo*, but the sinking of the *General Belgrano* and the subsequent withdrawal of the Argentine carrier robbed them of their chance to undertake any combat missions from their floating home. On 9 May, the eight serviceable A-4Qs deployed to Base Aérea Naval Rio Grande in the Tierra del Fuego area, where they were joined later by two other Skyhawks which had been put back into operational status.

From this southerly base, the flight performed a total of 30 attack and armed reconnaissance sorties, engaging in combat during nine of them. The relatively small number of engagements was due to the great mobility of naval targets, coupled with the considerable distance between Rio Grande and the theatre of operations and worsened by the almost total lack of reconnaissance and intelligence-gathering means. In addition, very poor weather conditions over the operations area and at Rio Grande caused a good number of sorties to be aborted, among them the last one flown by the flight on 12 June.

Three A-4Qs and two pilots were lost during operations (one in an accident). They caused telling damage that led to the sinking of two Type 21 frigates. These successes were, and are still, hotly disputed by the Fuerza Aérea, which claims that its Skyhawk and Dagger flights were responsible.

Refuelling from a KC-130H 'Chancha', a Grupo 4 de Caza A-4C heads towards the Falklands/Malvinas, clutching a single Mk 17 1,000-lb (454-kg) bomb to its belly. Grupo 4's A-4Cs were distinguishable from the A-4Bs by the longer nose (housing additional avionics) and the extra wing pylons, although the latter were not used. The aircraft retained their desert-style sand/brown camouflage, having yellow (later blue) identification bands added to avoid being shot down by friendly AAA. Grupo 4 suffered more than any other Argentinean unit, losing 55 per cent of its aircraft and 35 per cent of its pilots during the conflict.

Argentina's Skyhawks

In 1966 25 refurbished A-4Bs, serialled C-201 to C-225, were acquired by Argentina from US Navy surplus stocks. These aircraft were followed four years later by a second batch of the same quantity (C-226 to C-250), equipping Grupo 5 de Caza ('Halcones') of V Brigada Aérea at BAM Villa Reynolds, San Luis. These aircraft received the A-4P designation, indicating export, although it was rarely used. Approximately one-third of the fleet received an Omega navigation system after their arrival. In 1976 a third batch was acquired (C-301 to C-325), this time of the A-4C variant, which entered service with Grupo 4 de Caza, IV Brigada Aérea at BAM El Plumerillo.

In the late 1970s the FAA attempted to acquire more A-4Bs, but an arms embargo kept them in the United States. Even in late 1981, attempts were still being made to release 29 A-4Bs and 32 desperately needed spare J65 engines, but these were unsuccessful. Any hope of obtaining help from the US evaporated in April 1982 when the US announced its support for the British cause.

On 8 November 1970, the US Navy delivered the last of 16 A-4Q Skyhawks to the Argentine navy. The aircraft were former A-4Bs updated by Douglas (and redesignated) and they remained in the United States for pilot training. On 3 May 1972, the Skyhawks arrived in Argentina aboard the carrier *25 de Mayo*. Initially, pilots and ground crew had received training with Grupo 5 de Caza at Villa Reynolds, but subsequently the former trained at VA-12 at NAS Lemoore and the latter at MCAS El Toro. 2ª Escuadrilla within 3ª Escuadra was the initial operating unit, although this was soon redesignated as 3ª Escuadrilla de Caza y Ataque. Its shore base was at BAN Comandante Espora, Bahía Blanca.

Eight of the CANA's A-4Qs hold formation during a pre-war sortie from Bahía Blanca. Only eight aircraft were serviceable at the start of the war, although two more were subsequently repaired.

The acquisition of these little attack bombers was a revolutionary move for the small Aviación Naval. The A-4Q was its first high-performance jet suitable for carrier operations. The type's ability to carry diverse weapons allowed the training of pilots in new flying techniques such as anti-shipping strikes, air-to-ground operations, air-to-air combat and, of course, carrier operations in general.

Throughout its 18-year history, 3ª Escuadrilla has had a very important commitment to close air support (CAS) for amphibious operations carried out by the marines. Second came anti-shipping strikes and daylight intercepts, the Skyhawks carrying a pair of AIM-9B Sidewinders for the latter role. 3ª Escuadrilla created a new tactical doctrine in Argentine naval aviation, and in 1981 2ª Escuadrilla Aeronaval de Caza y Ataque was reformed with Super Etendards. 3ª Escuadrilla became the supplier of pilots for the Super Etendard unit. Like the Fuerza Aérea, the CANA was actively trying to obtain more modern Skyhawks from the US but failed due to the late 1970s arms embargo.

Of the three Skyhawk units, Grupo 5 de Caza was the most successful, inflicting two devastating blows on the British fleet. Here the bombs dropped by Primer Teniente Velasco slam into the side of HMS Coventry. *Nineteen sailors lost their lives in the attack: the rest of the ship's complement was rescued by HMS* Broadsword *before the Type 42 destroyer sank.*

Right: These eight A-4Bs (officially designated A-4Ps) are part of the 25-aircraft second batch supplied to the Fuerza Aérea Argentina in 1970. They are seen at Tulsa, fresh from refurbishment by Douglas (with B-47, B-52s and B-66s in the background). The Douglas upgrade added some A-4F features, notably the split flap/ spoiler arrangement.

28 March - early April 1982

25 de Mayo at sea

ARA* 25 de Mayo *was commissioned in 1944 as HMS* Venerable. *It later served with the Netherlands as the HrMS* Karel Doorman *before being sold to Argentina. Here it is seen post-war (note the Super Etendards).

In March 1982 3ª Escuadrilla had on strength 10 A-4Qs, of which eight were operational. Three were equipped with VLF Omega navigation systems: 3-A-301, -306 and -309. Shore-based at Comandante Espora Naval Air Station, the unit formed part of 3ª Escuadra Aeronaval (3rd Naval Air Wing), frequently deploying aboard the Argentine navy's only aircraft-carrier, ARA *25 de Mayo*.

3ª Escuadrilla had 12 pilots: Capitán de Corbeta Castro Fox (CO), Zubizarreta (exec) and Philippi; Teniente de Navio Lecour, Sylvester, Arca, Benitez, Oliveira and Rótolo; and Teniente de Fragata Marquez, Olmedo and Médici. The unit received orders to embark its eight available Skyhawks aboard *25 de Mayo* for scheduled exercises in the second half of March, and on 28 March the ship weighed anchor from Puerto Belgrano as flagship of Task Force 20 (Fuerza de Tareas 20).

The unit's mission in Operación Azul (codename for the amphibious landings near Port Stanley) was to provide cover for the assault forces of Amphibious Task Force 40. Lack of British airborne opposition made it unnecessary to use the A-4Qs, although one (3-A-305) was seen some days after the 2 April occupation operating from Port Stanley airfield, performing trials to determine if the aircraft could be forward-deployed there. The runway proved too short for safe operations, especially with a war load and in wet or icy conditions. With the Falklands secured, ARA *25 de Mayo* returned to its port and the A-4Qs flew back to their shore base at Espora.

Seen in its original markings, an A-4Q launches from* 25 de Mayo. *The aircraft serial later had '3-' added in front, the fuselage anchor was removed and the 'Naval' titles were exchanged for 'Armada'.

11-14 April 1982

Skyhawks move south

Soon after the Argentinean occupation of the Falklands the two Fuerza Aérea Skyhawk units – Grupo 4 and Grupo 5 – received notification to move to southerly bases and to prepare for war. Grupo 4 was the first to move, dispatching nine (some accounts say 12) of its A-4Cs to San Julian (a civilian airfield), on 11 April. From here they operated alongside the Daggers of Grupo 6. Grupo 5 sent 12 A-4Bs to Rio Gallegos on 14 April, this number being bolstered during the coming weeks as aircraft which had been unserviceable or undergoing maintenance were brought to combat readiness in a major effort undertaken at Villa Reynolds and Rio Cuarto.

Considerable work was undertaken at both bases to facilitate combat operations, especially at San Julian where temporary ramp space had to be provided by the use of emergency planking. As April drew to a close and the British Task Force sailed closer, tensions mounted considerably for the Skyhawk crews. Both units practised emergency evacuations as the threat of a pre-emptive air strike by Vulcan bombers increased. On 30 April, hours before the first Black Buck raid hit Port Stanley airport, Grupo 4 had to abandon San Julian for Puerto Deseado when an unidentified (and ultimately non-threatening) radar blip appeared heading their way. At the time it was thought that the most likely use for the Skyhawks would be in open sea anti-ship strikes, and much of April was spent honing low-level overwater flying skills.

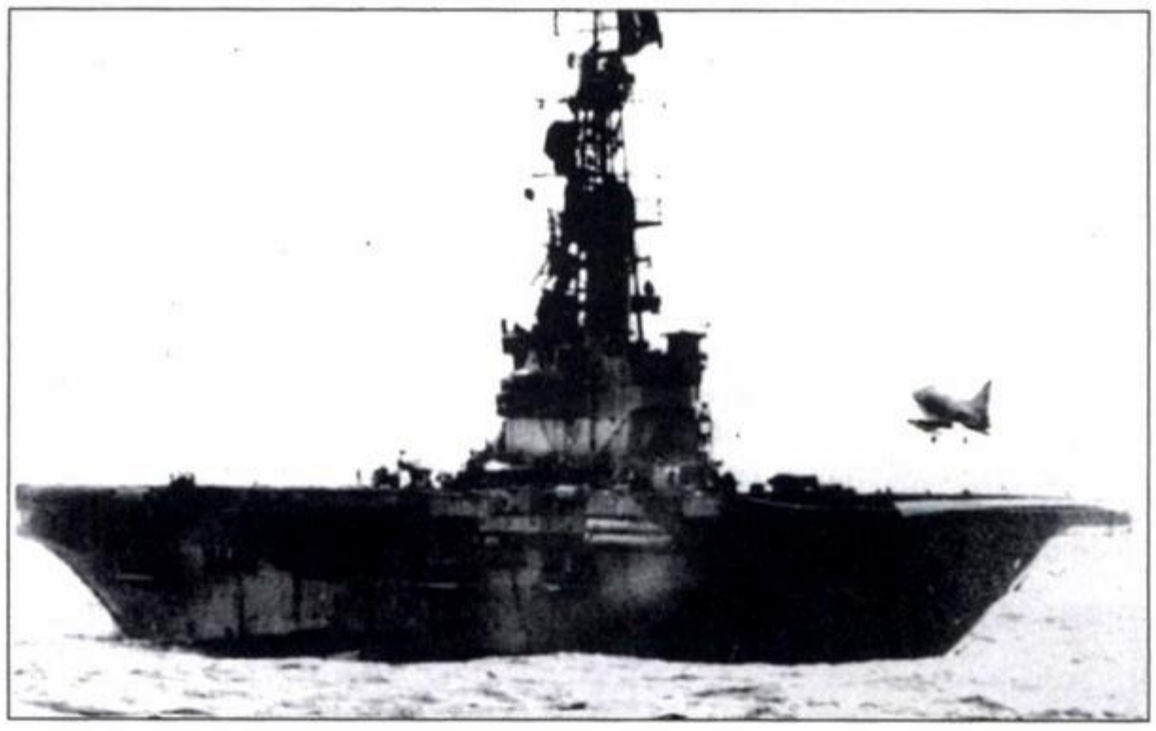
Conditions at the southern bases were difficult, both in terms of climate and facilities. These are Grupo 5's A-4Bs, the aircraft in the foreground displaying its airbrakes, split flaps and emergency arrester hook.

15/17 April – 5 May 1982

Carrier face-off

Having only just returned to port, ARA *25 de Mayo* put to sea again between 15 and 17 April, with eight 3ª Escuadrilla A-4Qs on board. As the British Task Force approached, the likelihood of an open seas battle grew and Task Force 79, of which *25 de Mayo* was a part, practised in anticipation of just such a battle. Naturally, the A-4Qs formed the major part of the anti-ship strike force and, like their air force cousins, the CANA pilots trained hard for attacks against major British ships, the two carriers being the prime targets. The CANA Skyhawks were not, however, involved in the first combat actions which occurred on 1 May.

On 2 May 1982, the day after the first RAF/Fleet Air Arm raids over the Falklands, the fleets of both countries were on the verge of a classic World War II-type action, with the Argentine task force sailing northwest of the Falklands. This was the only time that such an opportunity existed, and had an engagement taken place the course of the war could have been quite different. That day the Skyhawks were in a high state of readiness, seven loaded with six Mk 82 Snakeye bombs for a possible strike against the Royal Navy carriers. The remaining A-4Q was kept in air defence mode armed with two AIM-9Bs



An A-4Q traps aboard 25 de Mayo in late April when the carrier was part of Task Force 79. A combination of calm conditions and the loss of radar contact with the British Task Force conspired to keep the A-4s on the deck the only day they were potentially in range of the British fleet, although they were bombed up.

and carrying one centreline drop tank, and with the pilot already in the cockpit.

During the day, orders to launch the bombers were cancelled at least three times at the last minute. Officially, these cancellations were due to a lack of wind which made catapult launches with heavy bomb and fuel loads a marginal affair. In any case, the Royal Navy warships had moved to the east and the Grumman S-2E Tracker which had been shadowing them had lost contact. Later that day, ARA *General Belgrano* was sunk by its submarine shadow, and *25 de Mayo* was ordered back to port immediately to save it from a similar fate. Before returning to port on 5 May, 3ª Escuadrilla made nine air defence sorties from the carrier, trying to intercept radar 'blips' detected by the Argentine navy Type 42 destroyers. No visual contact was made.

These four A-4Qs are seen on 1 May, as armourers load them with six 500-lb Snakeye bombs each. One of the aircraft was fitted with AIM-9B Sidewinders and was placed on air defence alert.

A-4Q pilots and deck crew prepare on 1 May for their first mission against the British (in the event never flown). The targets were the carrier group, hence the inscription on the Mk 82 Snakeye bomb.

1 May 1982

An inauspicious start

Britain's Vulcan and Sea Harrier raids on Port Stanley airport and Goose Green were the opening shots of the war, and were the trigger for a well-rehearsed Argentinean response which involved a sizeable effort on the part of all attack units. It was the Argentinean belief that the first, inevitable, air raids by the British would herald an attempted landing by the Task Force: the military command had not banked on the softening-up period which ensued. Consequently, the pre-planned missions were concerned primarily with attacking ships undertaking the landings. Aircraft were to be launched in four-ship formations at regular intervals, receiving targeting data from the Falklands-based command centre as they neared the islands.

Grupo 4 was first away, launching four A-4Cs each carrying a pair of 500-lb bombs. The mission, as all others that day, was unrefuelled, restricting both bomb load and loiter/search time available. Grupo 6 Daggers and Grupo 8 Mirage IIIEAs provided fighter cover. In total Grupo 4 launched 16 sorties, which for the most part passed without incident. One flight, LANA led by Capitán Jorge Garcia, was forced back when a Sea Harrier CAP was vectored towards it.

On the other hand, two of Grupo 5's three missions led to near calamity. TOPO flight, led by Capitán Hugo del Valle Palaver, was vectored on to a target only to discover that it was not a ship, but a pair of Sea Harriers! Two covering Mirages recognised the ground controller's mistake and rushed to the Skyhawks' rescue, despite being low on fuel. Believing that the oncoming six aircraft were all Mirages, the Sea Harrier element elected to disengage, saving the A-4 flight from near-certain disaster.

A Grupo 5 pilot heads towards his A-4B for a dusk mission. Most of the wartime missions were flown in daylight, however, although the weather was mostly poor.

Grupo 5's next flight, TRUENO with Capitán Pablo Carballo in command, was quickly reduced to a three-ship when one aircraft turned back with problems.

The flight continued, and was rewarded with a target to the north of Port Stanley. All three A-4Bs made uncontested strafing and bomb attacks against the ship, but all failed to hit the vessel. This was indeed fortunate, for the next morning the pilots were informed that it was an Argentinean vessel.

May Day was something of an all-round disaster for Argentina. Twenty-eight Skyhawk sorties had been launched, and not one had even made contact with a British vessel. In the air the Sea Harrier/AIM-9L combination had proved itself to be a lethal one, and the legend of 'La Muerta Negra' had been born. The fact that there were no Royal Navy vessels involved in disembarking troops was an insurmountable flaw in an otherwise plausible plan. The only British vessels near the islands that day, quietly inserting Special Forces, managed to remain undetected, while the Task Force lay many miles to the east.

9 May 1982

First losses

Following the events of 1 May there was a week of little activity for the FAA Skyhawk units. By day the bulk of the British Task Force stayed well away from the islands outside the range of the A-4s, dispatching vessels mostly by night to maintain a harassing bombardment of Port Stanley. Appalling weather kept the Skyhawks on the ground although, elsewhere, the CANA Super Etendards were achieving success against the HMS *Sheffield*. Finally, on 9 May, CdoFAS received

9 May 1982

Navy Skyhawks move south

After their abortive cruise aboard *25 de Mayo*, the 3ª Escuadrilla A-4Qs were dispatched south to join the two air force units. The eight Skyhawks and 12 pilots began training operations from BAN Rio Grande, but it was not until the Battle of San Carlos opened on 21 May that they would be involved in action.

This was the last photo taken of C-303, refuelling from a KC-130H inbound to the Falklands. The aircraft and its pilot, Teniente Farias, were lost without trace to an unknown cause.

information on British warships close to the islands, and planned a series of missions. These were all cancelled or abandoned apart from one.

Led by Jorge Garcia, the Grupo 4 de Caza four-ship continued through worsening weather towards the Port Stanley area. Only two Skyhawks made it back to San Julian. One, C-313 flown by Teniente Jorge Casco, hit cliffs on South Jason Island, while the other, C-303 flown by Teniente Jorge Farias, disappeared without a trace. Casco's aircraft was found some while later by the British: the pilot was still in his seat and the bomb load was intact. It can only be assumed that both aircraft crashed while attempting to navigate through the terrible weather, although there is an outside chance that Farias was hit by one of three Sea Dart missiles launched by HMS *Coventry* against what was believed to be a 'C-130 with Mirage escort'.

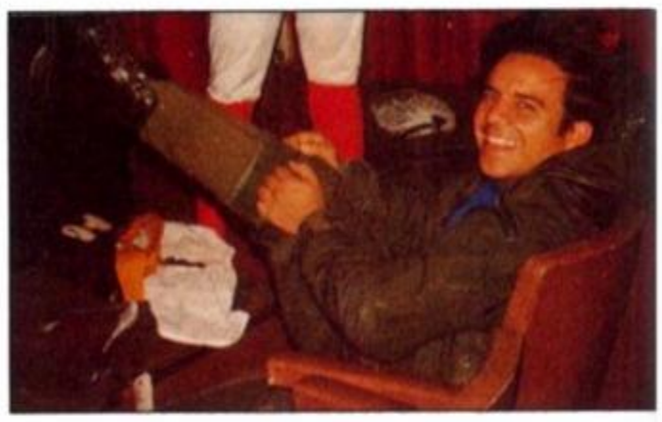
12 May 1982

The first hits – for four losses

12 May was a bittersweet day for Grupo 5 de Caza. Having not seen action since eventful 1 May, the unit was restless and anxious for the weather to clear and for the British to come within their range. Around mid-day notification came from CdoFAS that two British warships had been located, these turning out to be the Type 42 destroyer HMS *Glasgow* on the Stanley bombardment line, and its protector, the Type 22 frigate HMS *Brilliant*. Grupo 5's two alert flights were launched, first CUNA led by Primer Teniente Oscar Bustos, followed 30 minutes later by ORO, led by Capitán Zelaya. At this point of the conflict the A-4B missions were still being flown without tanker support, limiting the aircraft to one pass at the target.

CUNA flight located its targets easily, but the British had also seen the Skyhawks approaching, and had had plenty of time to prepare. Bustos, in C-246, led his wingman, Teniente Jorge Ibarlucea, in C-208, in at wave-top height, but *Brilliant*'s Seawolf system had no problem, and promptly dispatched them both. The second pair followed, and again a Seawolf was fired. Teniente Mario Nivoli, flying C-206, was killed when his aircraft struck the water, desperately trying to out-manoeuvre the missile. Alferez Jorge Vazquez made it through and released his bombs, but they were off-target.

Chastened by the almost complete destruction of the preceding flight, Zelaya then led ORO in for the second attack. As luck would have it, *Brilliant*'s Seawolf system crashed at a crucial moment, and although the two vessels put up a stiff gun defence, all the Skyhawks managed to make their attacks. Teniente Juan Arraras attacked *Brilliant* on his own, the ship turning its earlier bad fortune to good when the two 500-lb bombs hit the sea, bounced off the surface and flew clean over the ship.



A smiling Oscar Bustos pulls on his anti-g suit prior to the 12 May mission. He was killed by a Seawolf missile from HMS Brilliant, followed moments later by his wingman. They were Grupo 5's first losses.

***Above: Grupo 5 de Caza thought that it had sunk HMS* Brilliant *on 12 May and C-239 was accordingly marked with a ship silhouette, together with the date. In fact,* Brilliant *emerged unscathed, although the same attack put an unexploded bomb clean through* Glasgow.**

Glasgow was not so lucky. Attacked by the remaining three Skyhawks, it was hit by a bomb dropped by Primer Teniente Fausto Gavazzi. The bomb passed straight through the ship without exploding, causing no injuries or serious internal damage. However, *Glasgow* was left with two holes very close to the waterline, and despite rapid repairs was effectively removed from the conflict.

ORO flight escaped the area completely unscathed, and was feeling jubilant at avenging the earlier tragedy that had befallen CUNA flight. For some inexplicable reason, the victorious Gavazzi flew too low over the Darwin area, and was promptly brought down by Argentinean radar-laid 35-mm anti-aircraft fire. He ejected, but too late.

Despite the loss of four pilots and aircraft, Grupo 5 considered 12 May to be a success. The unit thought that it had sunk *Brilliant* as well as hitting *Glasgow*. Hard lessons had been learned by both sides, and when the Skyhawks returned to the fray they used considerably altered tactics which involved attacking ships from abeam, rather than from obliquely astern. The use of tanking would also be employed on most further missions, while the transit to the islands would be made at high level to avoid the hazards of prolonged overwater low-level flying (birdstrikes, inadvertently flying into the sea and salt encrustation build-up on the canopy).

Teniente Jorge Ibarlucea stands beside A-4B C-226 prior to the conflict – neither would survive it. Teniente Ibarlucea was the second scalp for* Brilliant*'s Seawolf system on 12 May, while C-226 was shot down by a Sea Harrier on 8 June with Teniente Arraras at the controls.

21 May 1982

Battle of San Carlos Water

As soon as the British Task Force arrived within striking distance of the Falklands, the Argentines could do little than await the inevitable landings, although they seized what few chances came along to attack British vessels. However, apart from the isolated engagements of 4, 9 and 12 May, the Argentinean anti-ship units had little to do other than practise and plan for the forthcoming British landings, when vessels would by necessity be densely packed close to the shoreline. In the evening of 20 May intelligence reports of unusual British activity began to be received. The Task Force stole into Falkland Sound in the night, and began landing troops in San Carlos Water. The Argentineans had expected a landing much closer to Port Stanley, but while San Carlos offered an easily defended anchorage, with the terrain channelling the attackers into one line of attack, the position on the west coast of East Falkland favoured the Argentines as it eased range problems and allowed for a wider variety of ingress routes. Argentinean plans for the attacks were a revision of those of 1 May, the main concept being to send in flights of attack aircraft one after the other to saturate and confuse the British defences. To a certain degree, the plan worked, but at a price.

Grupo 6's Daggers were the first to strike, swiftly followed by two flights, LEO and ORION, of Grupo 5 A-4Bs. Each flight had three aircraft armed with a single 1,000-lb bomb. Inflight refuelling was not employed on this mission. Arriving at the northern mouth of the Falkland Sound shortly after the Daggers had damaged *Antrim* and *Broadsword*, the Skyhawks spotted an unescorted frigate just off Fanning Head. T his was HMS *Argonaut*, a 'Leander'-class which had already been slightly damaged by an MB-339 rocket attack and had survived a Dagger attack. The ship's luck ran out when Grupo 5 appeared. Using the hills for terrain-masking to defeat radar-guided missiles, the Skyhawks appeared low and fast and put two bombs into the ship. Neither exploded, but one ended up in the boiler room while the other entered the forward magazine, causing two Seacat missiles to explode. *Argonaut* was towed into San Carlos Water, and after the two bombs had been made safe spent a few days as a gun platform before being towed away for repair and dispatch home.

The navy's 3ª Escuadrilla launched six aircraft on its first combat mission of the war, but there was insufficient intelligence available, and the aircraft were called back to Rio Grande before reaching the target area.

Ground crew cheer off a Grupo 5 A-4B from Rio Gallegos. The engineers performed sterling work throughout the campaign in keeping the Skyhawks airworthy, especially considering the amount of battle damage which was inflicted by the British defences.

21 May 1982

Attacking *Ardent*

While the British counted the cost of the first Argentinean attacks, the afternoon wave of strikes was getting airborne. First was Grupo 5's MULA flight, led by Capitán Carballo. This was the first refuelled mission for the Skyhawk, and the four-ship was reduced to three when one could not receive fuel. A second aircraft dropped out near the islands, leaving Carballo and Alferez Carmona to continue. Forced by bad weather to leave their intended track, the reduced MULA flight broke cloud near Swan Island, and saw a freighter. Immediately diving into the attack, the two prepared for bomb release. Alarmed at the lack of defensive fire, Carballo called off the attack, but it was too late, for Carmona had dropped his bomb. The vessel was the Argentinean *Rio Carcarana*. Whether Carmona's bomb hit was immaterial, for the ship had been abandoned days before after a Sea Harrier attack (it was later sunk by a Lynx Sea Skua attack).

Carballo continued alone and, with the element of surprise, came across HMS *Ardent*, a Type 21 frigate which was shelling Goose Green airfield from Grantham Sound. Carballo narrowly missed the ship with his bomb, but believed that he had hit it.

Carballo's flight had been due to make a co-ordinated attack with a Grupo 4 four-ship of A-4Cs. When he attacked *Ardent* he had aroused the interest of a Sea Harrier CAP, which instead ran into the hapless Grupo 4 flight. Once the Sea Harriers had been spotted, the flight jettisoned its bombs and external tanks, and broke away to the south to escape. The 'Shars' were too close, though, and a pair of AIM-9Ls was on its way in no time. The Sidewinder fired by Lieutenant Commander Mike Blissett in XZ496 hit first, taking out the Skyhawk of Primer Teniente Danial Manzotti, while shortly after the missile fired by Lieutenant Commander Neill Thomas hit the A-4 of Teniente Nestor Lopez. It is thought that Lopez managed to eject, but neither pilot survived. Blissett used his cannon to score a few hits on one of the other fleeing aircraft, but it survived to reach San Julian.

Having escaped Carballo's earlier attack, HMS *Ardent* then became the subject of a Grupo 6 Dagger raid, which put two bombs into the frigate. Although badly damaged and with its Lynx destroyed, *Ardent* headed for the safety of a group of ships near the mouth of San Carlos Water. Soon after, the unfortunate ship became the target for the CANA Skyhawks' second mission of the day.

Capitán de Corbeta (Lieutenant Commander) Alberto Jorge Philippi, leader of the ill-fated TABANO (horsefly) division which attacked the frigate HMS *Ardent*, provides a dramatic account of his first and last combat sortie on

The Fuerza Aérea had only two KC-130H tankers serving with Grupo 1 de Transporte's I Escuadrón, and both were heavily utilised in refuelling the Skyhawks, especially after 21 May.

21 May 1982.

"When we launched from Rio Grande on the afternoon of 21 May, our mission was to attack a Royal Navy frigate, supposedly on radar picket duties at the southern end of Falklands Sound or sailing towards this area. Shortly after take-off our command post at Rio Grande advised us that we could expect to find Sea Harrier CAPs nearby.

"After receiving this new information I wondered, half-amused, how I could be so cool. I was flying at maximum range over the ocean in a single-engined aircraft with a cracked right wing mainspar and a time-expired ejection seat rocket booster, and I had only a slim chance of being rescued if forced down. I knew that the two 20-mm cannon had only a 12 per cent probability of working properly without jamming.

"In fact, the only thing missing from this depressing picture was a bag of scorpions in the cockpit!

"While taxiing prior to take-off I had turned on all the armament switches, leaving only the master switch off. I knew that, sometimes, the high stress involved in a run into the target can cause mistakes, and I did not want to forget anything.

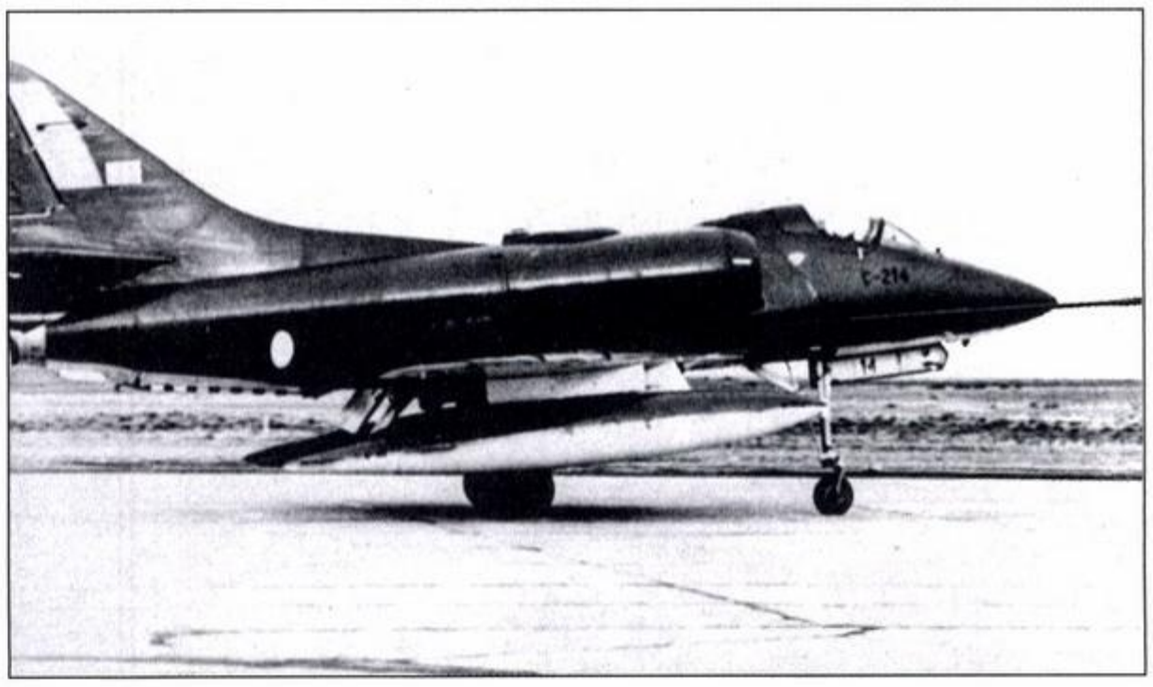
"Armament configuration was the same for each of us in my three-ship division (callsigns TABANO 1 myself, TABANO 2 Sub-Lieutenant Marquez, and TABANO 3 Lieutenant Arca). We carried four Mk 82 500-lb bombs with Snakeye retarding tails, plus 200 rounds for the 20-mm guns.

"The attack called for a low-level run at 450 kt and at 50 ft, to avoid radar detection until the last moment. At 1 nm from the ship we were to climb to 300 ft and commence our attack, firing the guns to 'keep their heads down' and waiting until the pipper's dot

Left: FAA personnel contemplate four 1,000-lb bombs at Rio Gallegos. Many Argentinean bombs failed to explode, mainly through having insufficient time to arm when dropped from low level.

Below: An A-4C refuels from the 'Chancha' (mother sow). Refuelling allowed the Skyhawk pilots greater flexibility when planning attacks.

Capitán Carballo, fresh from the 21 May mission during which he unsuccessfully bombed* Ardent*, uses the traditional fighter pilot method to recount his adventures to FAA chief and military junta member General Basilio Lamiz Dozo.



***A Grupo 5 A-4B taxis in at Rio Gallegos following a 21 May mission. The unit had a successful day, damaging HMS* Argonaut*, but it was left to the navy to score the biggest success of the day with the telling attack on* Ardent.**

passed over the bow to pickle the bomb's button. After delivery we would push the throttle to the firewall, and start evasive manoeuvres during the escape leg to avoid being locked by the fire control radars or the SAMs launched against us.

"The join-up after take-off was routinely carried out while we climbed to 27,000 ft, the planned height for navigating towards the islands. Distance to the target was 385 nm with descent from 100 nm away. By 50 nm we should be flying 100 ft above the sea. Total flying time to the target area was 58 minutes.

"None of the A-4s in our division had navigation computers nor Omega VL navigation systems, so I worked by magnetic compass and ADF marcations until we started our descent. Once at low level I navigated by dead reckoning and visual references, when I had them, taking into account that we were flying at about 475 mph.

"Then, on the horizon, I saw the islands – five minutes before ETA – somewhat blurred by low clouds. We obviously had a higher-than-expected tailwind.

"Nobody talked; all our tasks had been dealt with during the pre-flight briefing, contemplating all possible alternatives. Knowing that they (the British) had very good ECM and ESM, any radio chatter between pilots could mean detection even before entering radar range.

"While descending we turned on the master armament switch; now we only had to press the bomb button. We flew by Bird's Island, to the southwest of West Falkland/Gran Malvina, then turned right following the coastline until we reached Cape Meredith. We were flying below the cloud deck, which was approximately at 500 ft. Rain showers reduced horizontal visibility to one mile or less, prompting my wingmen to close formation to maintain visual contact.

"When we reached Cape Meredith, I ordered a left turn to cross the Sound's southern mouth. Cape Meredith was to our left – tall and menacing – its peak covered by clouds, and its steep slopes sank into an ocean as dark and unwelcoming as the cape itself.

"A chilling thought struck me. Visibility was much reduced, and if the frigate was in the Sound its radar would detect us and the ship could launch SAMs before we found it. We hadn't a chance, as we didn't have any means of telling if we were 'painted' by hostile fire control radars. The idea of making a 180° turn and returning home with my wingmen crossed my mind. It was fully justified; in fact, the A-4Q division which had launched before us did just that.

"I decided to make a short comment over the radio, which reflected the anxiety and stress of those moments. 'It's really long,' I said, referring to the width of the Sound which took four minutes to cross at our speed.

"Not finding the feared frigate I proceeded towards the secondary target, British ships in San Carlos Water. So, when we overflew the western shores of East Falkland/ Soledad, we established an 025° heading. Flying at 50 ft over the beach at 450 kt we were going directly to San Carlos, and were already spread in attack formation. I was in front in 3-A-307, Lieutenant Marquez in 3-A-314 was behind and to the right, while Lieutenant Arca in 3-A-312 was behind Marquez and to his left. As we went up the Sound, the weather improved somewhat: the clouds were scattered and we could see a nice blue sky. Shortly before reaching Grantham Sound we caught sight of the mast and radar antenna of a ship behind Northwest Island, which is a rock rising from the water near the shore on the northern side of the bay. I signalled the target's location to my wingmen, guessing the distance, and gave the attack order.

"My first thought was to attack directly, using the rock as cover during our attack run. But I had to change this plan due to the surprising speed with which the ship started to move, leaving the shelter of the rock and heading into deep water in the Sound. I glanced briefly at the clock: it was almost 15.00.

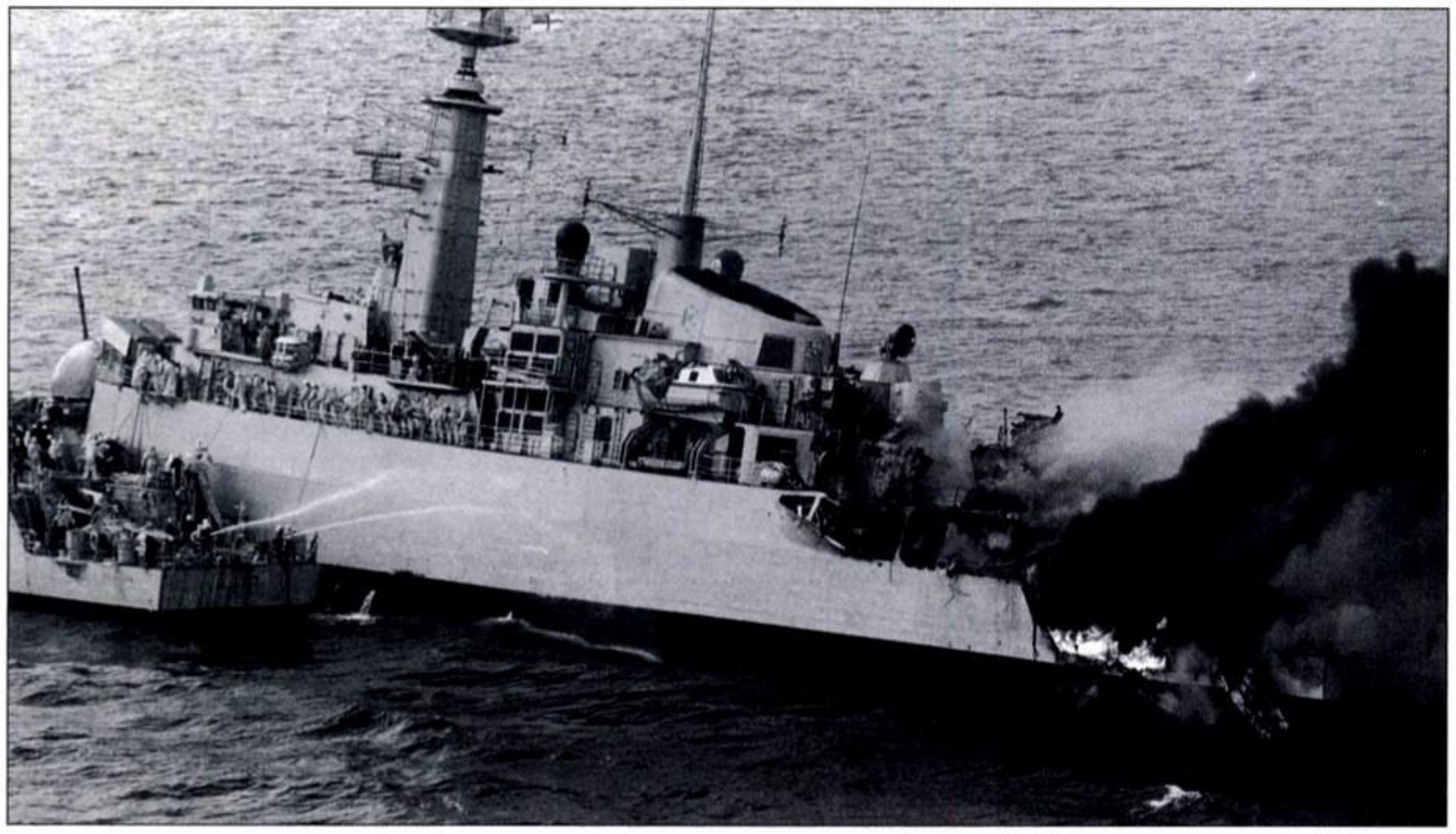
"When I saw the ship move, I thought it had detected us. I turned right so our formation could mix with the radar clutter from the shore, flying above it in an easy left turn. I got into a favourable position to attack in a diagonal run, from the port bow to the starboard bow, thus assuring a maximum impact probability. My wingmen were behind in the formation established before. A last glance at the fuel quantity indicator showed 4,200 lb remaining, about 200 lb above the 'Bingo' level. This was based on a 385-nm return leg, including a 50-nm low-level escape and a 100-kt headwind.

"When I calculated mentally that I was at the correct distance, I made a hard left turn towards the enemy vessel. When I completed the turn I was firmly established on the attack run, with approximately a 250° heading. I pressed the gun trigger, but after a few rounds both cannons jammed as usual!

"Lieutenant Arca, who was flying to my left, could not maintain his inside slot and skidded outside the turn, thus placing his Skyhawk as number two. In order to maintain the formation's integrity Lieutenant Marquez pulled to the left and took Arca's slot as number three. So our faithful Skyhawks made the attack run in the following order: 3-A-307 myself, 3-A-312 Arca and 3-A-314 Marquez. Our 500-lb Snakeyes were in a centreline MER (multiple ejector rack). A planned 250-millisecond interval gave the bombs a 40- to 45-m separation. The frigate's approximate heading was 225° and it was going at full speed while starting a turn to port. Then we were over the ship. While on the attack run, and also during the egress, I could see the firing of two missiles [in fact, the missiles reported by Philippi were Corvus

Capitán de Corbeta Alberto Jorge Philippi hit* Ardent *with two 500-lb bombs during the 21 May mission, but was shot down by a Sea Harrier soon afterwards. He survived the war, and later became commander of 3ª Escuadrilla.

A-4 Skyhawk in the Falklands



HMS* Ardent *was attacked three times on 21 May, first by a Grupo 5 Skyhawk, then by Grupo 6 Daggers and finally by 3 Esllа A-4Qs. The final attack left the ship burning and listing. It was abandoned, the crew being taken off by* Yarmouth, *and left to sink, which it did on the following day.

flare/chaff rockets]. I heard one of my wingman say, 'You've hit her, sir!'

"The nearby Sea Harrier CAP, which did not intercept us during the attack, jumped us from behind some minutes later during our egress along the Falklands Sound. They immediately shot down myself [Lieutenant Clive Morrell fired the shot from XZ457] and Marquez [gun kill by Flight Lieutenant John Leeming in XZ500]. Lieutenant Arca got to Port Stanley (Puerto Argentino), guided by the nearby Fuerza Aérea early warning mobile radar. His aircraft was full of holes from 30-mm gunfire [inflicted by Morrell] and both hydraulic control systems were inoperative. Once over the airfield Marquez tried to extend the landing gear but the left maingear had all but disappeared. Arca ejected over the bay beside the runway, and was rescued by an Argentine army UH-1H.

"Poor Lieutenant Marquez vanished without a trace. Weeks later Arca told me that he had seen the ugly fireball and subsequent smoke cloud made by his Skyhawk after it exploded. I remember quite frequently his anguished voice warning us of the Sea Harriers' presence. Gustavo was the unit's youngest pilot; his sense of humour and dedication to duty had won him the full respect of his fellow officers. Personally, he was the kind of wingman with whom I loved to fly.

"When I ejected after the Sidewinder hit me, the A-4Q was flying at 500 kt, with its nose slightly high, and at approximately 1,200 ft. I had both helmet visors up due to the low visibility and showers we had encountered over Cape Meredith. I took the decision to eject when I saw a Sea Harrier close to me – perhaps coming for a second try – although my aircraft ought to have seemed doomed with its tail blown off. I do not remember if I put my head firmly back against the headrest, or if I slowed to less than 350 kt to avoid serious injury, as is recommended in the NATOPS manual. After pulling the seat pan handle I heard a loud bang as the canopy was blown off and the seat ejected. There was a sharp pain in my neck and my last thought before passing out was 'I'm breaking my neck', just like Lieutenant Peña [this pilot broke his neck after ejecting from his A-4Q A-216 on 16 January 1973]. Regaining consciousness, I found myself hanging from the parachute over Falklands Sound and drifting towards the shore of East Falkland/Isla Soledad, near King Bay."

Philippi fell into the water and with great effort swam to the beach. He survived for several days until found by a group of kelpers, who treated him very well. Finally he was picked up by an Argentine helicopter, going first to Goose Green and from there to Port Stanley, being evacuated to Rio Gallegos on the mainland aboard a Fuerza Aérea C-130 transport. After the war he continued with 3ª Escuadrilla.

A second three-ship of 3ª Escuadrilla Skyhawks attacked about 15 minutes later, led by Teniente de Navio Benito Rótolo. Again poor *Ardent* was the target, but no bombs hit. By this time the vessel was doomed after Philippi's strike, the aft end set ablaze by two 500-lb bombs. Abandoned, HMS *Ardent* sank the following night. The afternoon's events have always been contested by the navy and air force, as to whether it was Dagger or Skyhawk which dealt the telling blow. The weight of evidence rests with 3ª Escuadrilla.

Mission Report – 3ª Escuadrilla raid

Day: 21 May 1982
Time: 15.01 Argentine (Zulu minus 3)
Target: Type 21 frigate located two miles to the north of Northwest Island in Falklands Sound

Composition of Attack Force
1st Division: 3-A-307 Lt Cdr Alberto Jorge Philippi, 3-A-312 Lt Jose Cesar Arca, 3-A-314 Sub-Lt Gustavo Marcelo Marquez
2nd Division: 3-A-301 Lt Benito Italo Rótolo, 3-A-305 Lt Carlos Lecour, 3-A-306 Lt Roberto Sylvester
Stores and armament configuration: four Mk 82 Snakeye 500-lb retarded bombs per aircraft, 200 20-mm HEI rounds per aircraft, two 300-US gal drop tanks per aircraft

Strike tactical procedures:
Low level approach (less than 50 ft)
Climb to 300 ft during attack leg
Dropping bombs with 250 millisecond intervals
Angle of separation between each attacking aircraft, approximately 30°

Chronology:
14.08: First division (307, 312, 314) launched from Rio Grande Naval Air Station
14.25: Second division (301, 305, 306) launched from Rio Grande Naval Air Station
14.50: First division starts descent for low-level leg
15.01: First division attacks Type 21 frigate in Falklands Sound, near Northwest Island and Grantham Sound
15.05: First division is intercepted by Sea Harriers during its escape. Two aircraft (314 and 307) are immediately shot down, while the third (312) is abandoned by its pilot due to damage from 30-mm gunfire
15.30: Second division attacks Type 21 frigate in San Carlos Sound beside Port San Carlos; escape as briefed
16.40: Second division lands at Rio Grande

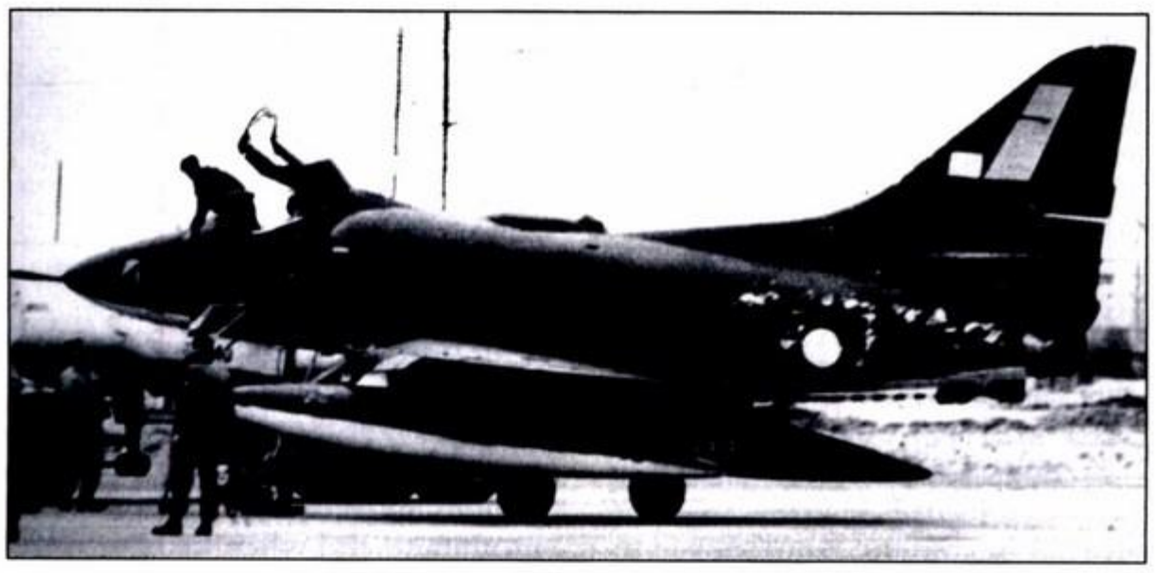
Notes: *Both divisions had the same mission and launch time hour, but problems with the Omega navigation systems of aircraft 305 and 306 forced the second division to be launched 17 minutes after the first, continuing its attack independently.*

3ª Escuadrilla Aeronaval de Caza y Ataque

3 Esllа was part of the CANA's 3 Escuadra Aeronaval. In addition to the Skyhawk squadron, 3 Escuadra also operated 1ª Escuadrilla flying the Alouette III/Lynx and 2ª Escuadrilla operating Super Etendards. 2 and 3 Esllа formed the main air wing of the *25 de Mayo*, together with SH-3s.

23 May 1982

Skyhawks return to San Carlos



An A-4B receives some maintenance at Rio Gallegos. The paintwork is already showing the strains of war.

After the considerable action on 21 May, the notorious Falklands weather played its hand the following day, preventing any Argentinean attack missions reaching the islands. This gave the British a day to consolidate the beachhead and to strengthen its defences. On the next day, 23 May, the weather cleared in the early afternoon, allowing the Skyhawks to resume their attacks on the British landing fleet. Sorties launched earlier in the day had in some cases been unable to even find the tanker. Inflight refuelling had now become routine on the outbound leg for all Skyhawk missions, including those of 3 Esllа.

First to attack that day was Grupo 5. Initially planned as a six-ship, two-flight mission, it was degraded to a four-ship before it left the ground; one aircraft encountered technical problems, while the pilot of the other absentee had injured his arm while falling off the wing of his aircraft! NENE flight, led by Capitán Carballo, continued to San Carlos Water, ignoring the Lynx helicopter of HMS *Antelope* which they overflew. *Antelope* itself lay in the anchorage, and the first pair of Skyhawks, flown by Carballo and Alferez Gomez, set up a low-level attack on the Type 21 frigate. One of their 1,000-lb bombs hit the aft part of the ship and stayed there, without exploding. Carballo's aircraft was the subject of withering fire and took many hits, including a near-miss from a missile. According to some British reports, Carballo hit the frigate's mast as he overflew it. Amazingly, he kept the Skyhawk in the air, and managed to nurse it back to Rio Gallegos. The bent fin under one of the fuel tanks lent credence to the British sighting.

Moments later, the second pair of NENE flight attacked the *Antelope,* putting another unexploded bomb into the vessel, this time in the forward part. Teniente Rinke survived the attack, but not Primer Teniente Guadagnini. His Skyhawk was hit by a SAM, either a Rapier fired from the shore or a Seawolf from HMS *Broadsword*. Although it appeared that *Antelope* had survived, the ship was evacuated so that bomb disposal teams could defuse the two unexploded bombs. During the night the bomb in the aft end exploded, killing the bomb disposal team. *Antelope* was left to burn until it exploded, breaking in half. By the next morning only the upturned bow and stern were visible above the water.

CANA Skyhawks also re-entered the fray on 23 May, using the four A-4Qs then left serviceable. The accompanying mission report outlines the 'bare bones' of the mission, which found targets (unidentified either at the time or subsequently), made attack runs but did not achieve any success. Remarkably, the three attacking aircraft emerged unscathed.

Castro Fox was fortunate, for he was flying one of the aircraft fitted with VLF Omega, and this navigation aid allowed him to make a precise plot for his return journey. Zubizarreta was less fortunate. With four 500-lb bombs still aboard, he had approached Rio Grande's runway with some trepidation and made a hard landing which burst a tyre. The aircraft failed to engage the emergency arrester wire, and skidded on the wet and icy runway. As it veered off the runway, and mindful of the four live bombs a few feet away, Zubizarreta elected to eject. The parachute failed to deploy properly, and the pilot died from his injuries later that day in hospital. Ironically, the aircraft suffered only minor damage, and was rapidly repaired.

It was left to Grupo 4 to play out the Skyhawk's final act that day, although the Skyhawks from San Julian failed to get through to their targets.

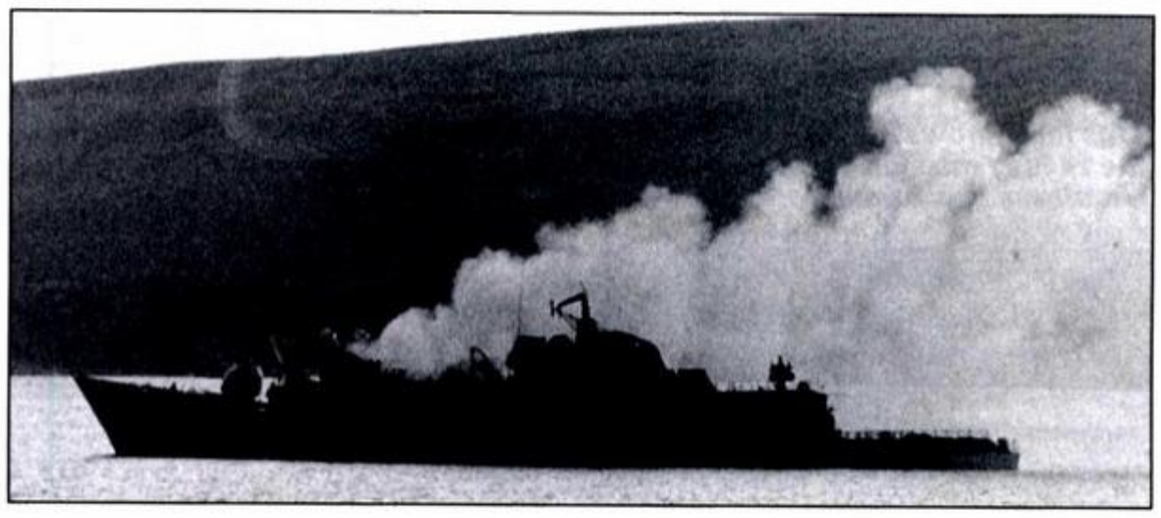
Mission Report – 3ª Escuadrilla raid

Day: 23 May 1982
Time: 14.09 Argentine (Zulu minus 3)
Target: Type 21 frigate detected in San Carlos Water

Composition of attack force:
3-A-301 Capitán de Corbeta Rodolfo Alberto Castro Fox
3-A-302 Teniente de Navio Marcos Benitez
3-A-306 Capitán de Corbeta Carlos Zubizarreta
3-A-305 Teniente de Navio Carlos Oliveira
Stores and armament configuration: as 21 May mission

Strike tactical procedures:
As 21 May mission
Chronology:
12.35: Division launched from Rio Grande Naval Air Station
13.20: air-to-air refuelling from Fuerza Aérea KC-130H tankers at 52° 30' S, 64° W
13.25: 3-A-305 returns to Rio Grande due to technical malfunction in the refuelling probe transfer system, landing at 14.00 at Rio Grande
13.50: 3-A-301, 302 and 306 enter the operations area
14.09: Visual detection of targets and attack
15.15: 302 and 306 land at Rio Grande
15.30: 301 lands at Rio Grande

Notes: *Aircraft 301, flown by the flight CO Capitán de Corbeta Castro Fox, suffered fuel problems after dropping its bombs and while jinking to avoid AAA/SAM fire; one of the drop tanks stopped transferring fuel to the main fuselage tank. Efforts to correct the failure were unsuccessful so he had to separate from his wingmen, radioing them to return independently to Rio Grande. Castro Fox aborted the low-level escape leg, jettisoning all external stores and performing a high-angle climb profile (fouled deck range) as recommended by the NATOPS manual. He landed at Rio Grande with only 200 lb (90 kg) of fuel remaining, having flown 380 nm (700 km) in marginal weather with a single-engined aircraft over the desolate and terribly cold South Atlantic Ocean.*
Capitán de Corbeta Carlos Zubizarreta, No. 3 in the division, had an electrical failure and could not launch his bombs.



Initially, the attack on HMS* Antelope *appeared to have failed, as the two bombs that hit the frigate did not explode. One later did while a team was trying to defuse it, leading to an uncontrollable fire (above). When the fire reached the magazine, the frigate blew up spectacularly, breaking its back and sinking during the night.

24 May 1982

A frustrating day

By the fourth day of the San Carlos landings the British had established a fearsome defence of the beachhead. Sorties against the ships there verged on the suicidal, yet the Skyhawks continued their assault. By this time the FAA had begun launching two three-ship flights minutes apart, sometimes with an air spare. Grupo 5's mission that day launched before noon, and is described by one of its participants, Teniente Luis Alberto Cervera.

"On 24 May two flights were at readiness at Rio Gallegos. The first, callsign NENE, was formed by the following pilots: leader, Vicecomodoro (Lieutenant Colonel) Mariel; No. 2, Teniente (Lieutenant) Roca; No. 3, Primer Teniente (First Lieutenant) Sánchez. The other flight, CHISPA, had as its leader Primer Teniente Berrier; No. 2, Alferez Moroni; No. 3, me.

"During that morning all of us, the pilots of II Escuadrón of Grupo 5 de Caza under the command of Vicecomodoro Dubourg, were called to the pilot's room for an extensive briefing concerning the tactics to be used during the next mission. After some discussions, the fragmentary order for the mission to be accomplished by the later flights arrived.

"From then on everything changed, there was constant activity. The pilots who remained helped as much as they could; we were already suited with the anti-exposure suit and the anti-*g* suit, we only had to put on the survival vest to be ready. We planned the navigation in accordance with the references provided by the FAS [Fuerza Aérea del Sur – Southern Air Force] staff.

"After everything was ready, we launched from Rio Gallegos and headed in absolute radio silence to the ARCP (Air Refuelling Control Point) where a KC-130H was waiting for us. We soon had a visual of the big Hercules orbiting at the briefed map co-ordinates. All six of us successfully engaged the drogues and then with the 'full' showing in the fuel gauges, disengaged. After this uneventful refuelling we started our descent to low level while we 'hotted up' our armament panel. It was while doing this that I saw the flight leader's bomb – we each carried a Mk 17 1,000-lb bomb on the centreline rack – drop, due to a short-circuit in the master armament switch. Without an offensive load, he had to turn back and I took his place. I gained a great wingman, Alferez Moroni, who closed formation until he was very near my Skyhawk, providing that kind of support that only an experienced 'wingie' can give.

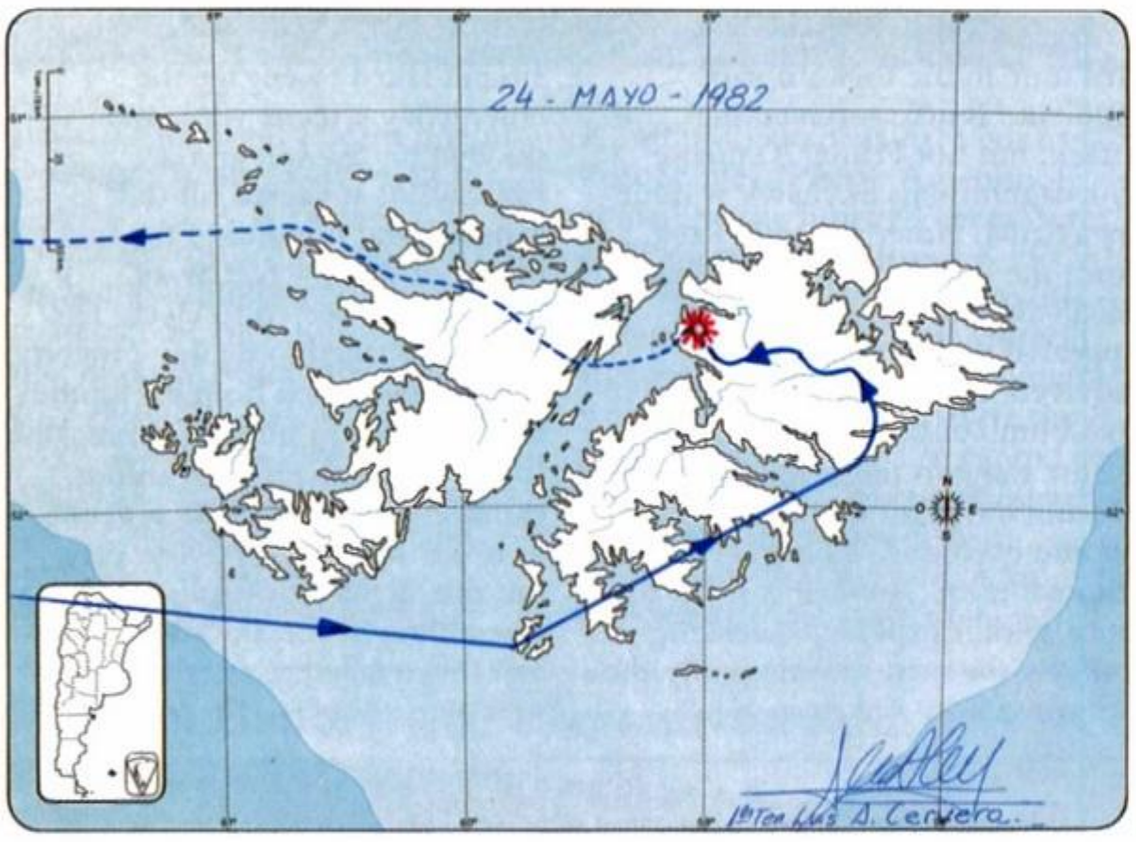
"After this episode, and once we had refocused our attention on the mission, we continued to fly about 3 miles behind Mariel's flight. Flying low over the water was difficult, since the sun was in front of us and its reflection on the water made it very hard to see forward. Due to these troublesome reflections, Mariel made a singular mistake when he exclaimed, 'Look in front!' We all thought it was a frigate and started our bomb run, but when closer we found that it was a rock rising from the ocean!

"After those nervous instants in which we expended a considerable quantity of adrenaline, we continued on our route as briefed, which basically consisted of overflying East Falkland/Isla Soledad, ingressing from the southwest. We would then arrive over San Carlos Water roughly in an east-west heading, with the sun on our backs, thus making it difficult for the AA defences to aim. After several changes of heading – we became somewhat confused due to the many coves and inlets which dot the shores of the island – we set the right course.

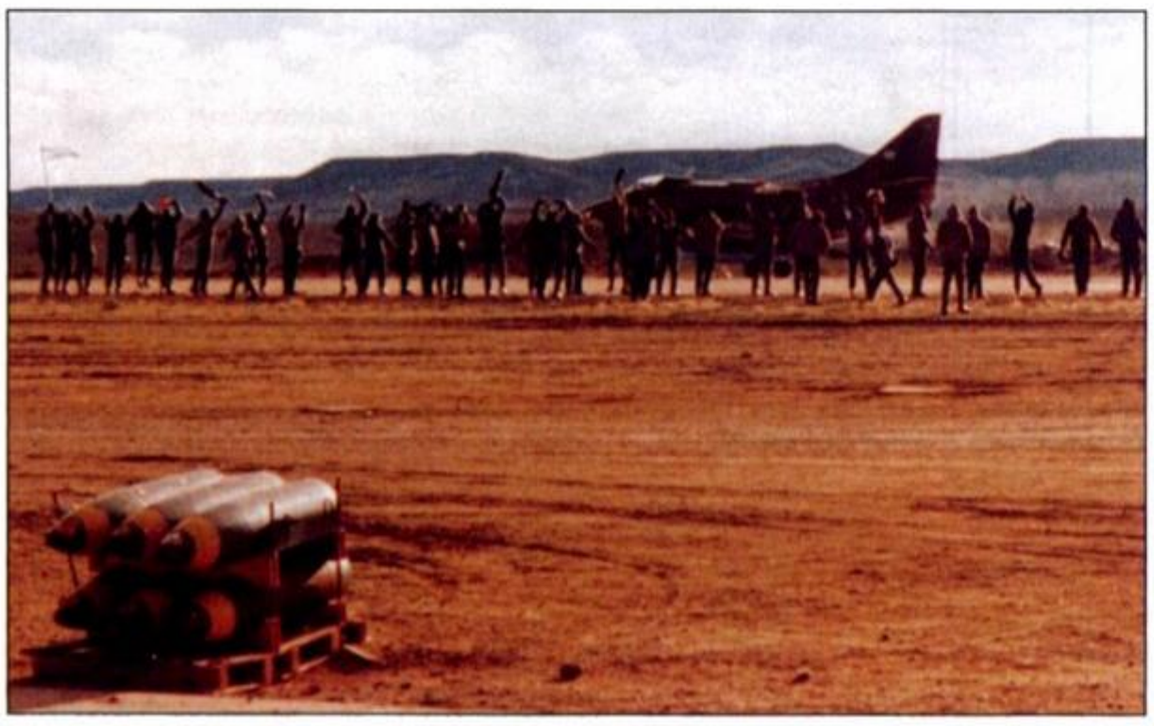
"We continued en route to the target in absolute radio silence, with only the sound of the jet engine, continually checking the navigation and engine instruments. Then I saw Vicecomodoro Mariel pulling up to overfly a small mountain, and when he was over the peak I heard in the headset a laconic 'They are there.'

"Instinctively, all of us pushed the throttles to the firewall, getting still lower over the rocky terrain, looking for the best ingress to San Carlos.

"I flew over the last hills and then, as in a giant theatre, San Carlos Water just appeared before my eyes, and the show was terrific! There were 10-12 ships on the calm waters, all forming the base for a cone of red tracers. The thought that nobody would leave alive from this hell flashed through my mind. After passing over the hill tops which surrounded the bay, I came down, literally scraping them and applying some negative *g*, which was uncomfortable but necessary when performing such terrain-masking manoeuvres. While doing this I lost sight of the preceding Skyhawks, then I reached the water and flew as low as I dared. I was doing about 500 kt, and my big dilemma was to choose a ship as a target for my bombs. Soon I saw what seemed an amphibious landing ship that was big enough, and I went for it. All my attention was concentrated on the target which, despite being relatively near, seemed to never get any closer because the AA fire was getting thicker by the moment and the tracers were passing very near and producing big splashes on the water; all this heightened my



This map shows the route taken by Luis Cervera and CHISPA flight during the 24 May mission to San Carlos. Refuelling allowed the A-4s to make a circuitous approach to arrive from overland.



Flag-waving ground crew send off an A-4B from Grupo 4. In the foreground are six finless 500-lb bombs.

Skyhawks wore various identification markings, several Grupo 5 machines displaying this vertical yellow fin flash.

Above: A Grupo 4 A-4C rests while on alert at San Julian. The outer wing pylons were unused during the war, but were subsequently wired to take either MATRA Magic or Rafael Shafrir air-to-air missiles.

Right: An unidentified Grupo 5 pilot checks the single 500-kg bomb on the centreline pylon. Unusually it is mounted on a triple ejector rack, rather than directly to the pylon itself.

anxiety to reach the target.

"When I was 5 ft over the water and 100 m from the ship, two A-4Bs crossed in front of me and launched their bombs, which hit the water a few metres away from 'my' ship's hull.

"At the height I was flying, the ship seemed very tall, and I was so close it seemed that I would hit it. I decided it was time to pull back the control stick against my stomach, while at the same time I depressed the bomb release button. I felt the centreline pylon pyrotechnic charge eject the bomb. Relieved of 1,000 lb of weight, the Skyhawk lurched upwards, and I passed over the helicopter deck almost scraping the rails. Over the ship I made a 90° angle of bank and tightened the turn as much as possible; when I was 90° off the previous heading, I brought back the A-4 to level flight, and pulling negative *g* I descended to sea level. It was then that I saw two 'things' pass by my right side flying faster than I was and leaving small plumes of smoke, and both blew up against the hillside. I assumed they were missiles. When I reached the hills I had to overfly to exit from 'Death Alley', I heard my wingman say in a panic, 'I'm hit! They've got me.' I ordered radio silence and instructed that if he decided to eject, to report over which place in order to alert the rescue forces.

"I was relieved after leaving San Carlos Water, although we still had the Falklands Sound and West Falkland/Gran Malvina to cross, where the risk of being shot down was still high. After leaving the last traces of land and getting over open ocean, I overtook Vicecomodoro Mariel's A-4B, grinned at him and left him behind. I set myself on the pre-established climb profile to a better cruise height, levelling at 25,000 ft on a direct heading to Rio Gallegos. With 200 miles to go before arriving home, Mariel checked with his flight. The only reply came from Teniente Roca, who said that Primer Teniente Sánchez was with him, and during the mission the latter reported trouble with the radio.

"Then I felt some anguish when I had to make the radio check, for I was uncertain that Moroni would reply. This concern lasted for about 20 miles, until at 180 nm from Rio Gallegos I called, and received the reply 'Great Tucu, we all return home in one piece!' ['Tucu' is Cervera's nickname and is an abbreviation of his native city, Tucuman.]

"We landed at Rio Gallegos and there, waiting for us with happy expressions on their faces, were the ground crews. These men were worthy of our highest esteem: they performed a great job 24 hours a day, mostly in the open (not a very nice proposition in this part of the country), readying our aircraft for the next mission. Once all of us climbed down and met on the dispersal, we hugged each other with the happiness of being together again and in one piece."

Following a post-flight debrief, it appeared that Cervera had attacked the RFA *Fort Austin*, but none of the Skyhawks managed a hit. Apart from the hits on Moroni's aircraft, all the A-4Bs emerged unscathed.

Over an hour later, it was Grupo 4's A-4Cs which put in an appearance. A flight of three led by Teniente Ricardo Lucero was the first in, and managed to survive the hail of fire in what had become christened 'Death Alley', though without success. They also evaded a Sea Harrier CAP. Following behind was Primer Teniente Jose Vazquez's JAGUAR flight which attacked shipping in San Carlos Water, leaving unexploded 500-lb bombs on both *Sir Lancelot* and *Sir Galahad* in their wake. All three A-4Cs were hit, but none worse than that of Teniente Jorge Bono. Bono struggled to keep up but soon fell behind. His Skyhawk lost height and eventually crashed in King George Bay. Despite frantic pleas from the other two pilots for him to eject, he did not do so, perhaps suggesting that he had been badly injured during the attack. The two survivors had to be shepherded back to San Julian by the KC-130H.

25 May 1982

Argentina's National Day

By the dawn of Argentina's national day, British forces were firmly entrenched ashore at Ajax Bay, and the day was regarded as the last in the Battle of San Carlos. Although the Argentineans scored two major victories that day (one by Skyhawks, the other being the sinking of MV *Atlantic Conveyor* by an Exocet), they also had several losses and by the end of the day any chance to disrupt or even halt the British landing had evaporated.

For the Skyhawks the day began before dawn. Intelligence had been received about a pair of picket ships operating to the north of Pebble Island which were providing excellent radar information about incoming air strikes. These were HMS *Coventry*, a Type 42 destroyer and its 'goalkeeper', the Type 22 frigate HMS *Broadsword*. An unusual dawn

These two photographs depict the damage caused by a single bomb dropped against **Broadsword** *by VULCAN flight. The bomb passed up through the flight deck (left), taking off the nose of Lynx XZ729.*

This remarkable photograph was taken from HMS* Broadsword *during VULCAN's attack, and shows the A-4Bs of Carballo (left) and Rinke as they attack the vessel at wave-top height. Mercifully, the bomb which hit the vessel did not explode.

HMS* Coventry *lists badly after the strike by Grupo 4's ZEUS flight. The ship sank about an hour after the strike. Today a memorial cross to the 19 sailors who lost their lives in the ship stands on Pebble Island, the nearest landfall to the south.

mission was launched by Grupo 5 in an attempt to catch them by surprise. After a night refuelling, the flight led by Capitán Palaver approached the ships, whose position had been relayed to the Skyhawks by a Grupo 1 Hercules. Without any warning and still some way from the targets, Palaver's aircraft exploded, killing the pilot immediately. He had been picked off by a long-range Sea Dart shot from *Coventry*. The mission was then abandoned.

Meanwhile, Grupo 4 had been preparing for its own missions against the British. San Carlos Water was the target and TORO flight, led by Capitán Garcia, took off as a five-ship. One dropped out soon after take-off, leaving the four to carry on to San Carlos, where they attacked shipping in a roughly line-astern formation. A wall of fire greeted them and only the No. 3, Teniente Paredi, emerged without a scratch. The No. 2, Teniente Lucero, was hit by a devastating combination of cannon and small-arms fire, and possibly a Rapier, too. He was fortunate to survive the ejection and was swiftly picked up by HMS *Fearless* and hospitalised. Garcia, the leader, had his bombs hang up during the attack run but managed to get away. However, as he egressed the area, a Sea Dart launched by *Coventry* shot him down without warning. He managed to eject, landing in the water, but neither side thought that he had survived. His body was found washed-up a year later, still in the survival dinghy. The No. 4, Alferez Gerardo Isaac, was far more fortunate. Hit by 20-mm cannon-fire, his A-4C was losing large amounts of fuel but he just about managed to reach the emergency tanker rendezvous. He flew hooked up to the KC-130H all the way back to San Julian, the first of several such 'saves' for the Skyhawk community. Although Isaac's Skyhawk was painted with a ship kill for that day, in reality Grupo 4 had failed again to cause the British any serious damage.

On the contrary, that morning, Grupo 5's blood was up. Eager to avenge the dawn loss of Palaver, and fed with excellent intelligence from both ground observers (the ships were only about 15 miles north of Pebble Island) and the Grupo 1 Hercules, Rio Gallegos prepared for another attack on the *Coventry* and *Broadsword*. The position of the radar pickets would allow the mission to be flown unrefuelled and, unusually, the aircraft were to carry three 1,000-lb bombs each.

Capitán Carballo led VULCAN flight off first, followed by ZEUS

Carballo's war

Capitán Pablo Marcos Carballo of Grupo 5 de Caza of the Fuerza Aérea Argentina was an experienced attack pilot with over 1,800 hours in the Skyhawk, and was a flight leader during the Falklands War. A few years later, as a major, he led a Mirage squadron within Grupo 6 de Caza at Tandil. Carballo's first notice of the Argentine landings near Port Stanley was in the early hours of 2 April 1982, while at Villa Reynolds, home of Grupo 5 de Caza. He gives his first-hand account of some of the events he experienced up to 14 June 1982, when the conflict ended.

"The atmosphere in my squadron was of comradeship, confidence and tension. We precisely understood the importance of the events, and were happy to become witnesses to them, although we clearly saw their implications and the unknown dangers that the immediate future held for us all.

"Most of Grupo 5 moved to Rio Gallegos, Patagonia on 14 April 1982. After establishing ourselves at this base, we had to become accustomed to the environment. All of us made orientation flights over the Falklands/Malvinas Islands. On 1 May we flew the first combat mission, which proved to be unsuccessful. Fortunately we didn't suffer losses. From then on we flew anti-shipping sorties with some success, such as damage to HMS *Glasgow*. On that day we sadly lost four A-4Bs, with no survivors among the unfortunate pilots. This was a hammer blow to all of us: four comrades, whom hours before had been living among us. And yet, the atmosphere at Rio Gallegos was extraordinary: our faith and morale were stronger than the fear of sudden death, as we clearly understood what we were fighting for.

"During the conflict, I logged a total of 19.55 combat hours over the islands, not counting training, armament practice, surveillance missions, etc., which I flew during those two months. On the combat missions, I reached the target on seven occasions and was hit eight times by the British anti-aircraft defences as follows:

"23 May – a surface-to-air missile (SAM) exploded below my Skyhawk, turning it upside down, damaging the rear end of the left drop tank;

"25 May – a splinter pierced the left wing;

"27 May – my Skyhawk sustained six hits: the first entered through the nose, impacted the left intake, pierced the navigation system cutting cables, and exited on the right side leaving a hole the size of a soccer ball; the second dented a thick metal plate; another broke a rubber conduit; another pierced a drop tank; and the last one went right through the tail pipe.

"On 21 May during my first attack against a frigate, and due to the desperation with which I pushed the throttle trying to get more speed out of my aircraft, I twice felt it slow down considerably. Without noticing, I had lowered the landing gear with my knuckle, which speaks volumes for the Skyhawk's strength! I carried a single 1,000-lb bomb that I dropped on HMS *Ardent*; my solo attack was observed by Alferez Egurza and Private Coronel, two members of the air observers net (ROA) established in the islands.

"As a flight leader, I had three pilots almost permanently assigned. We were

Capitán Pablo Carballo (centre) stands after the war in front of C-236, marked with Grupo 5's five kills. On the far right of the group is Teniente Rinke, while on the left is Primer Teniente Cachón, both members of Carballo's CRUZ flight.

***Teniente Lucero was one of two Grupo 4 pilots shot down during TORO flight's attack on San Carlos. He was fortunate, for he ejected safely and, despite having an injured leg, was quickly retrieved by sailors from HMS* Fearless.**

with Primer Teniente Velasco in the lead. Both started out as three-ships, but both suffered one aircraft dropping out with technical problems. As VULCAN began its descent the Port Stanley radar warned of a Sea Harrier CAP, but unbeknown to the Skyhawk pilots, *Broadsword*'s Seawolf system had already locked on and the ship had ordered the 'Shars' away to avoid them being hit accidentally.

Carballo and his wingman, Teniente Rinke, undertook a very low-level attack on the most westerly ship, which was *Broadsword*. At a crucial moment, the Seawolf system crashed, allowing the two Skyhawks an unmolested run-in, apart from light gunfire. Fortunately for *Broadsword*, all but one of the bombs missed, and that which did strike the ship had bounced off the water before passing up through the side of the ship, out through the hangar deck and away into the sea beyond, all without exploding. The biggest casualty was *Broadsword*'s Lynx, which had its nose taken clean off by the bomb as it exited upward through the deck.

ZEUS then commenced its run-in on *Coventry*, and again the Sea Harriers offered assistance. This was again denied by *Broadsword*, whose Seawolf system was now firmly locked on the two Skyhawks. *Coventry* launched a Sea Dart, but it was spotted early by the two Skyhawk pilots, and they evaded it with well-timed manoeuvres.

As they neared the destroyer, *Coventry* started evasive manoeuvres itself, and it was this which sealed the warship's fate. *Coventry* passed across the bows of *Broadsword*, breaking the lock of the Seawolf system. Velasco and his wingman, Alferez Jorge Barrionuevo, were also able to undertake an unopposed attack. Barrionuevo's bombs hung up, but all three of Velasco's slammed into the side of *Coventry*, and all exploded. Fire and flooding erupted internally, with severe loss of life. Twenty-seven minutes later *Coventry* was abandoned, and an hour after the attack it capsized and sank.

Grupo 4 adopted the standard yellow identification markings for its A-4Cs, but swapped these for blue later in the conflict. Yellow had not provided sufficient contrast to the sand camouflage.

A trio of Grupo 5 A-4Bs is seen through the windscreen of a fourth, pulling contrails. The A-4B was a pugnacious attack aircraft which belied its years. The survivors were not retired until the late 1990s.

assigned the tactical callsign CRUZ, and usually flew in the order of Leader, me; No. 2, Teniente Rinke; No. 3 (section leader), Primer Teniente Cachón; No. 4, Alferez Carmona. My flight was responsible for the attacks on the transports *Sir Tristram* and *Sir Galahad* on 8 June, although I had to abort due to a serious technical malfunction. On that day, when I got to my aircraft at the dispersal it had such a serious oxygen leak that I could hear the whistle from outside. Sargento Gamar, the crew chief, advised that I should not fly in these conditions as it could be a one-way ticket. I flew anyway and had trouble with the fuel system during the air-to-air refuelling stage, and then I had to return home at low level due to lack of oxygen.

"After the war, a British officer told one of our officers [a POW after the 14 June surrender] that, during our attacks on 25 May on HMS *Coventry* and HMS Broadsword, one of the ship's Seawolf missile fire control computers was activated when I attacked with Teniente Rinke. For several reasons, the FCS started to vacillate, then broke lock and went off, fortunately for us!

"One of the bombs I dropped on *Broadsword* hit the ship's stern without exploding, but it neatly chopped off the nose of its Lynx helicopter. After we dropped our bombs the frigate stopped and the FCS again got a lock, this time on Primer Teniente Velasco and Alferez Barrionuevo. Just as the missiles were to be fired, the destroyer *Coventry* moved between the Skyhawks and the frigate. Velasco's bombs hit the Type 42 destroyer dead centre, and it sank in about 20 minutes."

27 May 1982

Last trip to 'Death Alley'

With the British firmly ashore at San Carlos, many of the vessels had withdrawn and the area had become too well-defended to attack with any degree of safety. No missions reached the islands on 26 May, but on the following day Grupo 5 launched TRUCO and POKER flights on what appears to be the first attack aimed at British troops ashore, targeting the original landing area at Ajax Bay. It was also the last time the Skyhawks entered the hell that was San Carlos Water.

Capitán Pablo Carballo, leader of TRUCO flight, describes the mission.

"The frag order stated that we would attack British troop concentrations near San Carlos, who were thought to be advancing towards Darwin as night fell. We knew the importance of this mission, and it was one way for us aviators to co-operate with our troops.

"At this stage of the conflict, with several missions accomplished, we had two feelings: one was fear, because we knew what we could encounter, and the other was a strange feeling of exhilaration prior to the danger, which heightened all the senses and in some way made one feel invincible. Also, we felt a deep respect for the enemy, especially one as courageous and professional as the British.

"After preparing the navigation and warming up the Omega system, we cranked up our engines, taxied out of the dispersals, and gave the thumbs-up signal to the crew chief and the ground crew, who waved an Argentine flag at the side of the runway. We took off, and almost immediately my Omega became unusable, so I let Teniente Rinke take the lead. We rendezvoused with the KC-130H tanker exactly on time and then continued to our IP, on southwest West Falkland/Gran Malvina. Once there, Rinke asked, 'Sir, will you take the lead again?' I replied in the affirmative because at that time, and with several missions under my belt, I knew the islands quite well.

"Seven minutes later we were over Grantham Sound/Bahía Ruiz Puente. Two minutes behind us was another section [POKER] formed by Primer Teniente Velasco and Alferez Osses. Two abandoned orange dinghies on the beach caught my attention as I flew over the hills in front of us and went into San Carlos. There, it was like a 'holiday in Montecarlo'. It was late in the afternoon, the frigates were covering big transport vessels, about half a dozen helicopters were carrying slung loads to the beach, and everywhere there was activity. In front of us was the assigned target, San Carlos Settlement. As if somebody pushed a button, the afternoon sky was instantly covered with yellow-orange dots chasing each other. Just in front of us was a thick wall of AA fire.

"From the hill, projectiles came towards me, and just when it seemed they were about to hit, they passed on either side of my aircraft as if there were some kind of protective shield. The SAMs came up in pairs. Rinke shouted, 'What should we do?' and I replied, 'Go on, Rinke!' My immediate concerns were to actually see the target [40 Commando camp area] and to fly as low as possible. Now the frigates also started to shoot at us. We climbed to 250 ft, which was the height for dropping the bombs, and when my pipper was on the pier I pressed the bomb button, dropping them in sequence. Rinke told me later that the four bombs got a good separation. With my peripheral vision I saw tracers passing closer to me than the aircraft's wingtips and six of them hit my Skyhawk.

"Coming after us, Velasco and Osses made their runs on the refrigerator plant (we did not know it was then being used as a hospital). Osses took a hit on his drop tanks, while Velasco was riddled and his Skyhawk caught fire in the wingroot below the oxygen bottles. I shouted at him to eject, while he was flying over a rivulet and dodging the snow-capped hills. Finally he bailed out over West Falkland/Gran Malvina, and after some adventures was recovered by our forces. [It was not until 1 June that Grupo 5 received news of his safe return.]

"I then began to worry about my aircraft. Absolutely nothing worked. The radio was erratic, and with hand signals I indicated to Rinke to take the lead. While my mind worked on the possibilities of 'crossing the pond' in this condition, I formated on Rinke's wing, almost touching the waves. Suddenly, I saw two aircraft coming towards us at two o'clock. I thought they were Harriers. I tried to tell Rinke but the radio did not work. In desperation I pushed the throttle, overhauling him, banking the wings alternately and pushing the throttle to the firewall. He followed me!

"Then a thought hit me: Should I jettison the drop tanks to lessen the drag? They were scarce items, so I decided against it. Several minutes later, I indicated by hand signals to Rinke to take the lead again. We started to climb, getting into thick clouds, breaking out of them at 30,000 ft as the sun sank into the horizon and it started to

Above: The assault carrier HMS* Fearless *experiences a lucky escape while anchored in San Carlos Water, a logistic landing ship being seen in the background.* Fearless *and sister-ship* Intrepid *accounted for a Grupo 5 Skyhawk between them on 27 May, bringing down the aircraft of Velasco with 40-mm cannon fire.

Left: A pair of Grupo 5 A-4Bs heads for the Falkland Islands just after refuelling from the KC-130H 'Chancha'. Late in the war Grupo 5 dispensed with the yellow identification panels which its aircraft had worn earlier. Apart from the first few missions, the Skyhawks used a high-level transit to the islands. This made the journey easier, but required a hazardous let-down to low level for the attack run through often atrocious weather.

get dark. I knew that I was completely in Rinke's hands, and if I lost him I would have to eject because most of my instruments did not work.

"After a while he made hand signals to indicate that I should reduce my throttle setting to begin our descent, but he did not turn on his navigation lights. Again we entered the clouds, where it was hard to maintain position and I was continually extending and retracting the speed brakes. When I thought Rinke was looking at me, I made frantic signals for him to add a little power and to turn on the lights, but he continued in his way without hesitation. In my desperation, I started to insult him (he couldn't hear me) and every member of his family. He remained as cold as ice.

"After some agonising minutes, we broke through the cloud base. With Rio Gallegos's illuminated runway in sight, I forgot about good manners, overtook him and went straight in for a landing. Just after the wheels touched the concrete, the A-4 jumped like a wild horse, veering towards the side of the runway. One of the main wheels had been punctured by AA fire. I only just avoided going off the runway, and after I had stopped a pick-up van brought the access ladder.

Following Carballo on the 27 May mission was TRUCO flight, which experienced mixed fortunes. The leader, Primer Teniente Velasco (smoking cigarette, above), was shot down although he survived the ejection, while Alferez Osses (left) scored a hit on an ammunition dump.

"As I climbed down, Sargento Salinas shouted, 'Sir, you were very lucky!' I looked, and could see the aircraft's innards through a hole. Then Rinke arrived and we hugged each other. I did not know whether to thank him or to hit him. I started to question him: 'Rinke, why didn't you turn on the navigation lights?'

"'Sir, you're getting old. As flight leader, it must have been a long time since you flew in close formation!'

"Then I asked, 'Did you see those two Harriers that were on a reciprocal heading and almost intercepted us?'

"'They were Pucarás, sir!'

"Teniente Rinke was ice cold, unemotional: he did not smile or cry, did not talk much. In fact, he was extremely efficient and courageous, and had outstanding self-control. On 11 June we were ready to leave on a mission, and upon raising my head from some maps I met his stare, and noticed that in his azure-blue eyes there was a deep pain, as if he were suffering, but he said nothing and his hands – unlike mine – were steady."

Utilising intelligence from recent reconnaissance photographs gained by Grupo 1 Learjets, this attack caused considerable surprise and a few casualties among the British forces. Nevertheless, its achievements had been outweighed by the loss of yet another Skyhawk and, for the time being, CdoFAS left attacks against well-defended troop positions alone.

28 May 1982

Frustrated mission

No significant action was undertaken on 27 May, but on 28 May, with the battle for Goose Green at its height, Grupo 5 received notification of a possible target in Grantham Sound. Like the *Coventry* attack three days earlier, Grupo 5 used an airborne controller to aid the mission, flying in either a Learjet or Hercules. Teniente Luis Alberto Cervera flew on that mission, and describes the events.

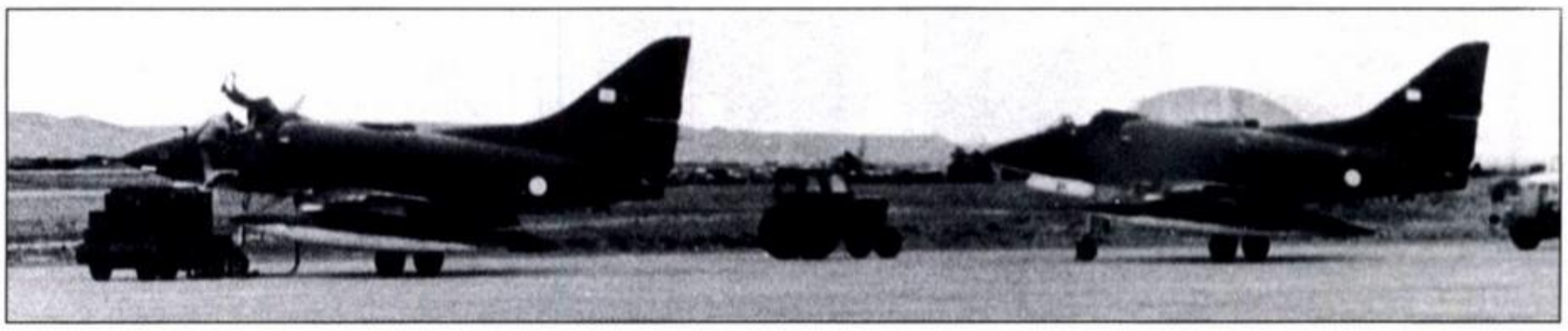
"We passed the morning hours slowly, chatting and sipping *mate* [an Argentine beverage similar to tea], trying to lessen the tension which accumulated among us. Everyone tried to make their flying kit as good as possible, adding candies and cigarettes to the survival kit; the basic idea was to be as comfortable as possible if one had to eject, which nobody wanted, but the way things were going it was a distinct possibility.

"The weather over the islands was unsettled and if the prepared strike were to be launched, I did not have a very clear idea what would happen. Two flights were at readiness, and these were its members: 1 – Capitán Varela, Alferez Moroni, Teniente Roca, and 2 – Vicecomodoro Dubourg [V Brigada commander], Alferez Vázquez, Teniente Mayor. I acted as spare in case any of them aborted.

"Sometime after noon, the low cloud base started to break up and the possibility of launching increased. All the assigned pilots were already suited up with flying kits when the frag order arrived from FAS HQ announcing the targets for both alert flights: two frigates seen near Darwin isthmus.

"After the briefing we went to our assigned Skyhawks. As I said before, I was spare, ready to take the place of any of the six if they had to abort. As such, the chance of me taking part in this mission was slim, but not impossible. All seven of us started up the J65s on the dispersal and both flights taxied to the runway's threshold, while I remained at the dispersal. From there, I watched the flight led by Captain Varela take off. Teniente Mayor, number three of Vicecomodoro Dubourg's flight, had a locked wheel and veered off

While A-4Bs are prepared in the background, ground crew at Rio Gallegos personalise a 500-lb bomb with a message for the Task Force.



Two A-4Bs sit on the Rio Gallegos flight line, awaiting their next mission. The base was also home to Daggers from Grupo 6 de Caza.

One of Grupo 5's A-4Bs was delivered to Rio Gallegos straight from the workshop, and was given a simple grey paint scheme, leading to the nickname 'El Tordillo' (the dapple-grey horse). This photo of the aircraft armed with three 500-lb bombs shows that it was at least earmarked to have had ID bands.

the taxiway, and his Skyhawk bogged down in soft ground. I was ordered to take his place in the formation.

"I made a fast taxi to the runway, trying to make the pre-take-off checks as quickly as possible since the five A-4s were already in the air. After taking off and climbing to 20,000 ft I established the course to the KC-130H tanker, expecting to arrive on time and join the other Skyhawks. This lonely navigation over the unforgiving ocean was worrying: if something happened to me, nobody would ever would find a trace. I was nearing the AARCP and started to search for the tanker and the 'little chicks', and I was so anxious that I imagined I could see their 'dots' everywhere. I continued for a few more minutes at the same speed and height, and then I saw the A-4s milling around the KC-130. When I was closer, I distinguished which drogue was free, so I went towards it. Once near the basket I moved the throttle to idle and deployed the speed brakes in order to slow down and not overtake, engaging at the first try. Since this operation was performed in absolute radio silence, nobody had noticed my integration into the formation. When I had the tanks full and withdrew from the Hercules, my dilemma was where I should formate, as I did not know who was who. I waited for the five aircraft to establish route formation and then I identified Capitán Varela's A-4B as the 'dapple grey horse', so-called because it had just undergone an overhaul and been sent to Rio Gallegos as a replacement without receiving the typical camouflage coat. Then I could identify the respective flight leaders.

"I formated on Vicecomodoro Dubourg's wing, but he did not understand at all: he had arrived at the AARCP with one wingman and after topping up found that he had two! While flying close to the leader at low level over the frosty South Atlantic Ocean, I was checking my instrument panel when I heard – even with the helmet – the powerful staccato of guns. Surprised, because I did not know where they came from, I looked up and saw flashes projecting from the cannon muzzles and a thin trail of smoke from the lead's Skyhawk. He was test firing the guns to check if they worked correctly, without thinking that under radio silence this could cause his wingman to have a heart attack. After we landed we laughed at him a long time for doing such a thing, which Dubourg took well.

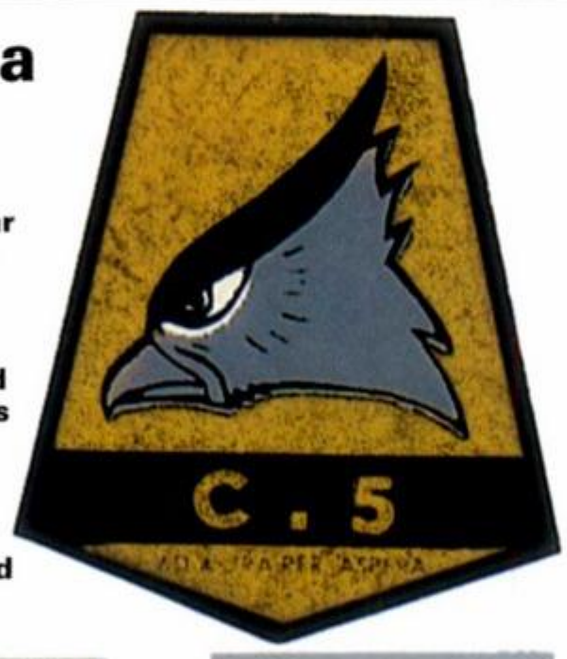
"When we arrived at the islands the cloud cover was very low, with rain squalls. We ingressed without knowing what to expect, but as we flew near West Falkland Island the cloud base started to rise, settling at about 20-30 m above the ocean. Now we could identify the rocks close to the shore. Once we crossed Falklands Sound and were over East Island, we turned left and established a northerly course for Grantham Sound. We overflew a hilly area which reduced the clear space between the cloud base and the ground, almost reducing visibility to zero, so we had no alternative but to make a left turn and continue flying to the target, but now over the Sound.

"We were very disappointed, after such a risky low-level navigation, to arrive over Grantham Sound and find nothing. We were not resigned to returning to base without finding a target. Capitán Varela and his flight continued to the northern mouth of the Falklands Sound, while Vicecomodoro Dubourg chose to perform a 180° turn over the Sound, adjacent to San Carlos Water. The cloud base was then roughly 20 m above the water, and to both sides of the sun the shore rose in almost vertical walls. It was quite impressive, like making this manoeuvre inside a shoe box. I was flying as No. 3. Halfway into the turn, so as not to lose sight of the others, I decided to tighten my turn in order to reduce the radius of the circle. This way, I would shorten my separation and not lose Alferez Vazquez's A-4 in the clouds. But, sometimes things do not develop as one wishes, and I finished up almost at the rivets of his aircraft! To avoid what seemed to be an imminent mid-air collision, I crossed to the other side, going through the reduced space between him and the water. This was the only possible way of making this change of position, for doing it over Vazquez was out of the question because of the low clouds and the risk that I would lose sight of everything in such a narrow place. Fortunately the manoeuvre went well, but it is still engraved in my mind as a colour picture, with the oil-stained belly of Vazquez's Skyhawk. After all three of us were on a roughly south heading, we could relax a little. We tried to find a secondary target without any luck and, much to our sorrow, diminishing fuel levels forced us to return to our base with the bomb loads still attached. Thanks to God everybody returned. Although the terrible weather complicated and frustrated our mission, it had the same effect on the British defences, which never had us within sight. That night our squadron CO bought us several rounds of whisky in the mess."

The other Grupo 5 flight did make contact with a British vessel that day, but it was quickly recognised as the hospital ship SS *Uganda*, and promptly left alone.

Grupo 5 de Caza

Known as 'Los Halcones', and featuring a hawk as its badge (right), Grupo 5 de Caza was home-based at Base Aérea Militar Villa Reynolds. It detached most of its A-4Bs to BA Rio Gallegos for war duty, moving to San Julian towards the end of the conflict. The grupo was arranged into two squadrons (Escuadrones IV and V), each of which consisted of three flights (escuadrillas) of four/six pilots. The six escuadrillas all had their own badges, which are presented below.



30 May 1982

Sink the *Invincible*

Of all the aerial missions flown during the Falklands War, none was more controversial than the joint CANA/FAA attempt on the British carriers on 30 May. On no other mission did the accounts from the opposing sides differ so wildly. Since 25 May neither the FAA nor CANA had been able to undertake any meaningful anti-shipping missions, as the British vessels had either withdrawn or were too well defended. Similarly, it was considered to be extremely foolhardy to attack British ground forces. CANA's Super Etendard force still had one Exocet (an open-sea weapon) to deliver, the most obvious target being the British carriers now sailing well to the east of the islands.

CANA had originally planned its Super Etendard mission for 29 May, but at a late stage it was decided to add four Fuerza Aérea Skyhawks to the formation, with the Super Etendards providing overwater navigation up to the point of missile release. Grupo 4's A-4Cs were chosen as they were marginally better equipped for long-range flights than the A-4Bs of the more successful Grupo 5. The two Skyhawk flight leads, Primer Teniente Ernesto Ureta and Primer Teniente Jose Vazquez, were informed of the mission in the late morning of 29 May, and left with their wingmen, Primer Teniente Omar Castillo and Alferez Isaac, for the ferry flight from San Julian to Rio Grande. It was only then that the two wingmen were informed of their mission. As the afternoon wore on, the CANA pilots argued that such a mission could not be launched without a much longer briefing. Good sense eventually prevailed, but by the time the Super Etendard pilots were given the go-ahead for an unescorted mission, the vital KC-130H tanker announced that it could not stay around long enough to meet the requirements of the Super Etendards. The original mission, complete with Skyhawks, was rescheduled for the following day.

The mission got under way just after midday, ALA flight of two Super Etendards (only that flown by Capitán de Corbeta Francisco carried an Exocet) followed by the four A-4Cs of ZONDA flight. The six aircraft flew in a loose gaggle at 20,000 ft until meeting the two KC-130H tankers way to the south of the Falklands, which they skirted by a wide margin to avoid detection. A long refuelling bracket ensued, with all aircraft taking on fuel several times. A turn northeast took the eight aircraft towards the British carriers, and at about 190 miles, roughly due south, from the last known position of the ships ALA and ZONDA flights dropped away from the tanker and descended to 100 ft, underneath a heavy overcast and heavy rain. Unbeknown to them, the British had already detected them, although when they dropped to low level their progress could no longer be tracked. Nevertheless, the British were on guard.

Such conditions were meat and drink to the Super Etendard pilots with their excellent navigation equipment, and they began their customary pop-up manoeuvres to allow the radar to sweep the sea ahead. Some two hours into the mission the pilot of the lead 'Sue' broke radio silence to announce that he had found the target, 'a large warship'. At a distance of about 20 miles, the Exocet was launched and the Super Etendards turned for home. Moments before, the British had realised that they were under Exocet attack, and rapidly launched chaff rockets and chaff-laying helicopters.

It had been envisaged at the planning stage that the Exocet would hit its primary target, one of the British carriers, and that the four A-4s should follow in with two 500-lb bombs each. It was hoped that in the panic caused by the Exocet strike the Skyhawks would have an unimpeded approach. In the event, the Grupo 4 pilots lost sight of the Exocet in the poor weather soon after it had been launched, but they continued their approach. At about 10 miles they made out a warship on the horizon, which appeared to be making smoke. Convinced that this was the *Invincible*, the A-4s continued. In reality, the vessel was HMS *Avenger*, a Type 21 frigate which was southeast of the main carrier group, acting as a radar picket. To the northeast was the Type 42 destroyer HMS *Exeter*, which in hindsight appears to be the most likely target found by the radar of the Super Etendard.

Exeter had launched a Sea Dart at the incoming Exocet, but this appeared not to hit the missile. Quite what did happen to Argentina's last air-launched Exocet has never been ascertained:

Right: Alferez Gerardo Isaac was one of two Grupo 4 pilots to survive the 30 May raid, and it was his evidence, along with that of Primer Teniente Ureta, which initiated the controversy over the achievements of the attack.

Below: Taken from the KC-130H, this photograph shows ALA flight of two Super Etendards leading ZONDA flight A-4Cs as they began their descent for the attack run on the Task Force. Adding Skyhawks to the last CANA Exocet mission was far from successful, and was largely a result of an inter-service political, rather than operational, decision.

Grupo 4 de Caza

Grupo 4 was the flying component of IV Brigada Aérea at Base Aérea Militar El Plumerillo, Mendoza. The brigade consisted of a base group, technical group and the flying group. The latter had two squadrons (Escuadrones I and II) flying the Morane-Saulnier MS.760 Paris and another flying a few F-86F Sabres. These units undertook light attack and weapons training duties. Escuadrón III was the main operational unit, this being the squadron flying the A-4C. At the end of 1983 Grupo 4's surviving Skyhawks were transferred to Grupo 5.

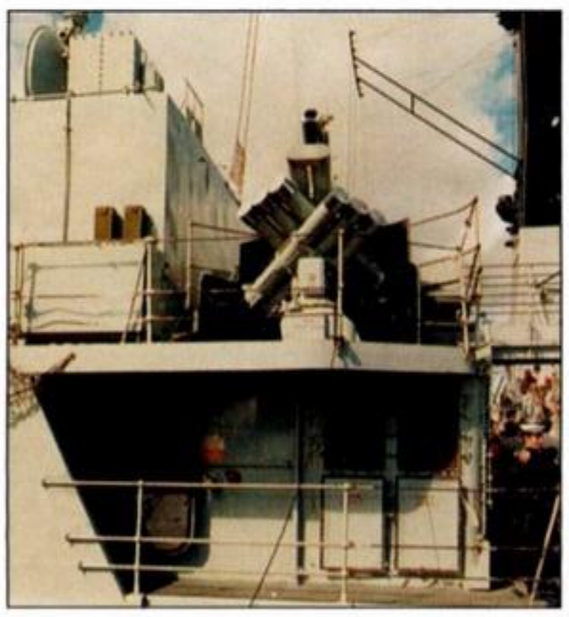
Seen shortly after the war, this Grupo 4 A-4C is one of two which were marked with a silhouette of* Invincible*, together with the date '30.5.82'. Note the silhouette of the Falklands/Malvinas to the right of the Grupo 4 badge.

Avenger claims that it shot it down with its 4.5-in gun – more likely it was decoyed away by chaff and continued, unseen, out over the south Atlantic before running out of fuel. However, *Exeter*'s second Sea Dart launch did find the A-4C of Vazquez (although again there is a slight possibility that *Avenger*'s gun was the cause), the aircraft exploding almost immediately and giving the hapless pilot no chance. Considerably shaken, the three remaining Skyhawks pressed on towards the 'smoking' target. At about two miles out, a third Sea Dart from *Exeter* chopped down Castillo. Despite being buffeted by the explosion, the two remaining A-4Cs continued their attack, passing low over the stern of *Avenger*. None of the four bombs hit the vessel and the Skyhawks left the area at high speed and low level for the long and uneventful journey back to Rio Grande. The mission had lasted 3 hours 47 minutes.

It was only after Ureta and Isaac's return that the controversy began. There seems little doubt that the two pilots were convinced that what they had flown over was a damaged *Invincible*. This is understandable for a number of reasons: they had expected it to be *Invincible* from the moment the 'Sue' pilot had located the target, while the extremely poor weather severely restricted visibility. *Avenger* was manoeuvring hard and was making smoke to distract the incoming pilots. Flying extremely low and very fast in such conditions, and concentrating on avoiding missiles and aiming bombs, it is entirely forgivable that the two pilots reported as they did.

In reality, the British Task Force vessels received no damage that day, and *Invincible* itself was some 20 miles north of *Exeter*, well out of range of the Exocet from its launch position more than 40 miles away. Back in Argentina, the A-4C pilots received a heroes' welcome, and the following day Argentina's national press was splashed with the headlines (and faked pictures) reporting major damage to the aircraft-carrier. This is also not surprising in the wider context of the progress of the war. The breakout from the beachhead at San Carlos was in full flow, and the battle for Goose Green had been lost. Little stood now stood between the British and the range of hills guarding Port Stanley itself. Here Argentina would make its last stand after having failed to stop the British coming ashore, while suffering increasing losses. The 'attack' on *Invincible* provided a timely rallying call to boost morale, both at home and on the islands.

For the British the 30 May mission was another chastening reminder about the power of the Exocet. Although all available intelligence pointed to the fact that Argentina had no more Exocets left, the British would not take any chances and, besides, the FAA may have attempted another long-range Skyhawk strike. Accordingly, the carriers remained way to the east of the islands, from where the Sea Harriers operated at great range. CAPs were fewer and briefer than they had been in the early part of the war. Indeed, CdoFAS came under the illusion that the Sea Harrier threat had largely been negated (as it, too, believed that *Invincible* had been incapacitated). A lack of Harrier coverage was (incorrectly) seen as one of the many contributing factors nine days later, when Skyhawks inflicted the deepest wound of the whole campaign to the British forces.



HMS* Exeter *(below) was the vessel responsible for shooting down two of ZONDA flight, using Sea Dart missiles. It was also probably the radar blip seen by the Super Etendards. Part of the ship's defences were Corvus chaff-dispensing rocket launchers (left).

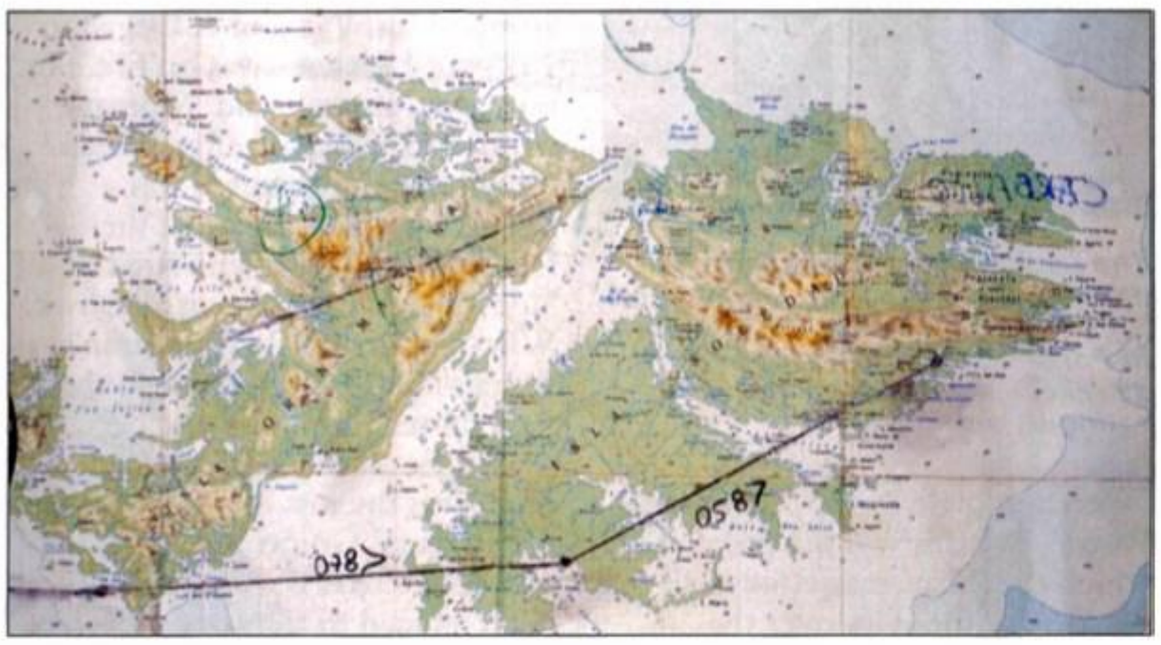
31 May – 7 June 1982

Time to rest

Apart from the notorious *Invincible* raid, the last days of May and the first week of June were a period of little combat activity for the Skyhawks. The weather remained poor over the islands and there were no obvious British ship targets. The time was spent wisely, though, for the units spent their time reviewing tactics (in the light of the overall British successes against the low-flying aircraft). New pilots arrived to replace those lost, while the maintenance teams had a breathing space to patch up the aircraft and bring them back to combat condition. The high level of operations during the Battle of San Carlos had taken a heavy toll on the aircraft themselves and on spares availability. The period of inactivity allowed these to be made good while, for the weary pilots, it was a time to rest. However, on the ground British troops were marching ever closer to Stanley.

8 June 1982

Black day for the Task Force



This was the map used by Grupo 5 for its devastating attack on British shipping at Port Pleasant. To the Argentines, the main Falkland Islands were known as Isla Gran Malvina (West Falkland) and Isla Soledad (East Falkland).

Nine days after Argentina's last meaningful action against British forces, and with no evidence of any concerted air operations against ground troops, it was perhaps forgivable of the British to attempt the risky landing of troops at Fitzroy settlement to complete the southern jaw of the pincers which would move on Stanley. Since the breakout from the beachhead, one group of land forces had 'yomped' across the north of East Falkland, while another had taken the Darwin/Goose Green area. The final battles would inevitably take place in the range of hills that guarded Port Stanley, and to hasten the installation of a southern flank the British elected to move much of the 5th Infantry Brigade by sea to recently vacated Fitzroy, landing troops from the water of Port Pleasant.

The Port Pleasant/Fitzroy area was close to Stanley, and had originally been earmarked by the Argentinean high command as the most likely location for a British invasion – San Carlos had been second on the list. The caution shown by the British in choosing San Carlos, with its high mountains offering natural protection on three sides, was thrown to the wind in order to expedite the end of the conflict. Port Pleasant was surrounded by low coastal terrain, and offered no geographical protection or vantage points upon which to place defences. This apparent carelessness was exploited to the full by the Argentineans, who had observation posts nearby feeding excellent intelligence back to CdoFAS. As it turned out, timing was everything. Unlike the Battle of San Carlos, when the ships themselves, aided by shore-based Rapier units, formed the main defensive screen, as will be seen it was the presence or otherwise of Sea Harrier CAPs which was the principal measure of success or failure for the attackers.

Armed with intelligence that the British had established a second anchorage in Port Pleasant, CdoFAS rapidly organised a series of strikes against the ships. Grupo 5 was notified to load up two flights of four Skyhawks, each armed with three 500-lb bombs. Just before midday DOGO flight, led by the redoubtable Capitán Carballo, launched from Rio Gallegos, complete with his usual flight of Rinke, Carmona and Cachón (these four had survived several missions together and were one of the few escuadrillas to have survived thus far intact). Soon after, MASTIN flight, led by Primer Teniente Filippini, took off. Problems at the refuelling bracket, when the probes were reported to have frozen, led to three of the eight turning back. Both flight leaders were among the casualties.

Without an experienced leader, the Skyhawks continued as a single arrowhead formation of five, led by Primer Teniente Cachón.

Their routing took them across Lafonia, and as they neared the target they spotted a Sea King, which was avoided by a change in course. A similar deviation took them round an Army Scout. The formation flew across the Fitzroy area, drawing much small-arms fire which damaged one of the Skyhawks, but a second pass revealed the main prize: the logistic landing ships RFA *Sir Galahad* and RFA *Sir Tristram*, which were at the time attempting to unload the Welsh Guards at Fitzroy. The Skyhawks attacked from the east, and apart from one SAM which exploded harmlessly between the aircraft of Cachón and Rinke, the attack was unopposed.

The first three aircraft went for *Sir Galahad*, and Cachón put all three of his bombs into the ship's stern. Carmona's bombs missed and Rinke failed to get his away, distracted by a frantic call from Carmona, which turned out to be a cry of anguish at his bombs missing! Behind them came Teniente Galvez and Alferez Gomez, who attacked *Sir Tristram*. Gomez's bombs fell short but those of Galvez hit the target. As they sped away, the five Skyhawks left a scene of pandemonium and panic in their wake.

Sir Galahad was on fire, the bombs having set off ammunition on board, and despite the heroic efforts of Royal Navy Sea King pilots and those on board, the loss of life was horrific. *Sir Tristram* had faired better, for the two bombs which hit her had not exploded, and only small fires were started. Although she was initially abandoned, the ship was later towed away for repairs. *Sir Galahad*, however, burned for a week before being towed out to sea and eventually sunk as a war grave on 26 June. The raid had cost the British 51 lives and at least 64 injured, mostly Welsh Guardsmen. It was the worst single loss on the UK side of the campaign. To underline the fact that the Fuerza Aérea was still a threat, Grupo 6 Daggers had almost simultaneously caught HMS *Plymouth*, causing serious damage.

Criticism was subsequently levelled at the non-appearance of Sea Harriers during the crucial attacks on Fitzroy and *Plymouth*, but there were mitigating circumstances. Firstly, the Port San Carlos temporary airstrip, from where the Sea Harriers had begun operating to increase their CAP time, had been put out of action by an accident involving an RAF Harrier, requiring that all CAPs be

This was the last known photograph of Teniente Arraras, seen refuelling in C-226 while carrying three 500-lb bombs on Grupo 5's second mission to Port Pleasant. Arraras was shot down by a Sidewinder fired from the Sea Harrier of Flight Lieutenant Dave Morgan low over Choiseul Sound.

The 8 June attack caused major damage to* Sir Tristram *(above) and* Sir Galahad *(left). The latter is seen in Port Pleasant where it had been attacked, after the fires had been extinguished.

flown from the distant carriers. Secondly, the Fuerza Aérea had used its Grupo 8 Mirages to launch a decoy attack on the beachhead at San Carlos, four aircraft flying Dagger profiles before turning away. The 'Shars' had naturally been vectored towards them. Lastly, the Sea Harriers had then given chase to the Daggers attacking *Plymouth*, and had very nearly caught them. With such thin cover, and a large amount of Argentinean action occurring simultaneously, it is understandable that the Sea Harriers failed to intervene.

Having scored a crushing blow, Grupo 5 and CdoFAS would have been fully justified in settling for the day's work as it stood, but instead they decided to follow up with more strikes. Having tasted outright success, they wanted more, and thought that Port Pleasant was the place to achieve it.

When Grupo 4 visited the Fitzroy area, they were looking for troop positions rather than ships. This is the A-4C of Teniente Paredi seen dropping away from the KC-130 on the 8 June mission.

Of course, by this time, the British had rapidly installed a fearsome array of defences to make up for any carelessness they had shown earlier.

Nevertheless, MAZO flight from Grupo 5 launched for an anti-shipping mission in mid-afternoon and headed for the Fitzroy area. Unlike the earlier flight, they were met by a wall of fire which ranged from small arms up to Blowpipes and Rapiers. None of the Skyhawks was hit, but this was clearly no place for an attack. They turned south, and were soon rewarded with a target, though small. It was the landing craft *Foxtrot-4*, from HMS *Fearless*. Two of the A-4Bs dived to attack, led by Primer Teniente Bolzan. In the lead, he had too little time to aim properly, and did not release. Behind him, Alferez Vazquez lined up the hapless craft and scored a direct hit. The small vessel sank within minutes of the attack.

As the two Skyhawks dived to the attack, they were spotted by a pair of No. 800 Squadron Sea Harriers. Up to that point Grupo 5 had, almost miraculously, not suffered a single loss to 'La Muerta Negra', but this was the point at which the 'Shar' reasserted itself as the king of the skies over the Falklands. The Sea Harriers dived on the Skyhawks and at close range Flight Lieutenant Dave Morgan fired an AIM-9L which impacted the A-4B of Teniente Arraras, killing the pilot. Teniente Sanchez saw the attack, and yelled for the others to break, but it was too late for Vazquez, whose aircraft was hit by Morgan's second Sidewinder. As his Skyhawk disintegrated around him, Vazquez managed to eject but his chute was on fire. His body was never found. Morgan continued the chase after Bolzan, using his cannon, but it was Lieutenant Dave Smith in the second Sea Harrier who fired a Sidewinder at his fleeing Skyhawk. Whether the missile hit Bolzan's aircraft before it crashed into the sand dunes on the Lafonia beach cannot be ascertained, but the cold result was the loss of another experienced Grupo 5 pilot. Grupo 8's Mirage IIIEAs, recently reintroduced to the conflict, were supposed to have been providing top cover for the attack, but they never left their perch at 35,000 ft, presumably unaware of the drama unfolding seven miles below. More

Above: It was a landing craft such as this one which was sunk by Grupo 5 on its second outing of 8 June. This minor success cost the 'Halcones' three Skyhawks.

Above: Grupo 4's 8 June mission encountered fierce ground fire from the British around Fitzroy, which separated YUNQUE flight completely. Seen after its return to San Julian, this is the aircraft of Alferez Codrington, exhibiting the result of a hit to the top of the rudder.

Douglas A-4B Skyhawk Grupo 5 de Caza San Julian June 1982

Accommodation
The pilot sat on a Douglas Escapac 1 seat, which had been modified by Stencil. The seat was advertised with zero-altitude capability, but a malfunction killed one CANA pilot when he attempted a runway ejection.

Cannon armament
The A-4 was armed with a pair of Colt-Browning Mk 12 20-mm cannon in the wingroots, with 100 rounds per gun. These were extremely unreliable and were disliked by the pilots. The CANA's A-4Qs also had AIM-9B Sidewinder capability for a limited air defence role.

Bomb armament
The standard bomb load during the early days of the war was a pair of 500-lb bombs. From 21 May this became a single 1,000-lb bomb (as illustrated) or three/four 500-lb weapons. These were para-retarded for low-level deliveries. Grupo 4 is recorded as having used 'anti-personnel' bombs against British troop positions.

Fuel
Internal capacity was 770 US gal (2915 litres), but for Falklands missions the two 250-US gal (946-litre) tanks were always carried. From 21 May inflight refuelling was employed to give the Skyhawks longer in the combat area.

Argentinean Skyhawks
Skyhawks were procured for the FAA from 1966 to replace Gloster Meteors and North American F-86Fs in the attack role. The A-4Bs had all been held in storage, and were overhauled by the Douglas Aircraft Company at Tulsa, Oklahoma, prior to delivery. A total of 50 A-4Bs was received. The 25 A-4Cs which followed in 1975 were reworked by Lockheed Aircraft Systems at Ontario, California. The navy's 16 A-4Qs were overhauled by Douglas at Tulsa, and were delivered in 1971.

Of all the Argentinean attack units committed against the British Task Force, Grupo 5 de Caza operated the least capable aircraft, yet it was this unit which scored the most successes. It inflicted the most devastating loss on the British with the 8 June attack at Port Pleasant which left RFA *Sir Galahad* devastated and *Sir Tristram* badly damaged. It was also responsible for the sinking of HMS *Coventry* on 25 May, another tragic loss of life. Grupo 5 also suffered the heaviest of any Argentinean unit, losing nine pilots in 10 aircraft losses.

C-207
This aircraft survived the war and was marked with two ship kills. One represents HMS *Coventry*, attacked and sunk on 25 May, while the Type 22 silhouette is thought to represent HMS *Brilliant*, which Grupo 5 believed it had sunk on 12 May. In fact, the bombs dropped that day bounced off the water, clearing the ship by a matter of feet. C-207 was seen briefly in July 1982 wearing five ship kill marks, representing the main achievements of Grupo 5 de Caza.

Spoilers
During rework prior to delivery to Argentina, the Skyhawks were fitted with the inner wing spoiler developed for the A-4F. This was essentially a split flap, the lower portion drooping as a conventional flap, while the upper portion could be raised to dump lift.

Powerplant
The A-4Bs of the Fuerza Aérea Argentina were powered by the Wright J65-W-16A turbojet, rated at 7,700 lb (34.25 kN) thrust. The CANA's A-4Qs, although they were also reworked A-4Bs, were powered by the J65-W-20, offering 8,400 lb (37.37 kN) thrust. The J65 was a development of the Armstrong Siddeley Sapphire, and was a single-spool turbojet with a 13-stage compressor and two-stage turbine. From the A-4E onwards, the Skyhawk family switched to the more efficient Pratt & Whitney J52.

Sea Harriers attempted to engage the Mirages, but to no avail.

Meanwhile, the sole survivor of the flight, Primer Teniente Sanchez, had managed to escape from the hell over Choiseul Sound, but he then faced considerable difficulty as he was down to the last few pounds of fuel. His aircraft lacked IFF or Omega, and had been one of the aircraft pressed into service without a full avionics fit. Realising his predicament, the KC-130H tanker headed towards the Falklands, well inside Sea Harrier range, and descended into the contrail region. Thankfully for the Argentineans, it was spotted by Sanchez rather than a Sea Harrier, and a nervous refuelling allowed the Skyhawk to reach Rio Gallegos safely.

As if the near-complete destruction of MAZO flight was not enough, CdoFas had ordered another flight, Grupo 4's YUNQUE, into the Fitzroy area for an evening raid. The four A-4Cs were armed for an anti-personnel raid, ordered to attack any troop concentrations which they found. Once in the general vicinity, the brightly burning *Sir Galahad* offered an unmissable aid to navigation. By sheer luck the Skyhawks survived the wall of gunfire which greeted them, although all were hit, and by equal luck their bombs caused no serious damage to the British. However, YUNQUE flight was completely scattered by the defences, one aircraft flying south in preparation for the pilot to eject, although he then found that there was no need. Another headed over Mount Kent where British ground troops put up such a hail of fire that it was almost a miracle that the Skyhawk came through. Two of the machines had punctured tanks and the two KC-130Hs, fresh from saving the survivor of MAZO flight, had to tow the aircraft back to San Julian. Disconnecting right over their home base, the two Skyhawks recovered without problems, but one was leaking so badly it flamed out while taxiing. The damage inflicted to YUNQUE appears to have brought Grupo 4's war to an end: without sufficient serviceable aircraft they could no longer continue.

9 June 1982

Move north for Grupo 5

Teniente Luis Alberto Cervera: "On 9 June we had to redeploy both A-4B squadrons to San Julian to join the A-4C squadron already operating from there, while in turn the Dagger squadron went to Rio Gallegos. I made this particular flight with Capitán Varela and Primer Teniente Sánchez. In order to practise low-level flying we cut across the ocean, going 25 miles from shore, as a pilot needs a lot of practice to train his eyes to this form of flying and any mistake could mean a wet grave. While flying with the formation in combat spread, my heart started to beat faster – I had noticed that slowly but progressively the EGT indicator was descending. I took advantage of my speed of 480 kt to climb as hard as possible while turning towards the mainland, so I could be over solid ground if the engine stopped. When I passed over the beach the EGT had reached 0°C, but the old J65 continued to run smoothly. After landing at San Julian we found the cause of such anxious moments had been a malfunction of the engine instruments.

"We had to adapt quickly to the new environment at San Julian air base – sleeping quarters, mess, etc. The change was significant, for at Rio Gallegos we had felt at home and had received the attention of the civilian community from the nearby city. Although the same happened at San Julian, it was still different to us. A few hours after arriving everybody had quarters, either within the base or in hotels at San Julian city. Despite the high losses suffered, the morale of Grupo 5 de Caza was high. For example, of the 17 pilots posted to our squadron at the start of the hostilities we had lost nine, but our fighting spirit was as intense as on the first day. We had received new replacement pilots fresh from operational conversion, plus transfers from the other component squadron of Grupo 5."

[II Escuadrón was hard hit, as it suffered 90 per cent of Grupo 5's losses in aircraft and pilots; I Escuadrón lost only one A-4B, and its pilot survived.]

Grupo 5 pilots are seen at their new base at San Julian. The airmen's relaxed look could possibly be explained by the fact that this was taken a few days after the Argentine surrender. The snowy conditions were typical.

8-12 June 1982

CANA's last missions

The CANA's 3ª Escuadrilla had not been able to mount any attacks since 23 May, and had been reduced to just two serviceable aircraft. By the second week of June the situation had improved somewhat and the unit was able to launch a flight on 8 June against British positions on Broken Island, with no tangible results. On 12 June two Skyhawks were launched on a mission to the Darwin area but the presence of a Sea Harrier CAP forced them to return to Rio Grande. Finally, on 12 June, another pair launched but, having failed to find targets, they came too close to a Sea Harrier CAP. Both pilots jettisoned bombs and tanks and made good their escape. Thus ended the CANA Skyhawks' contribution to the war.

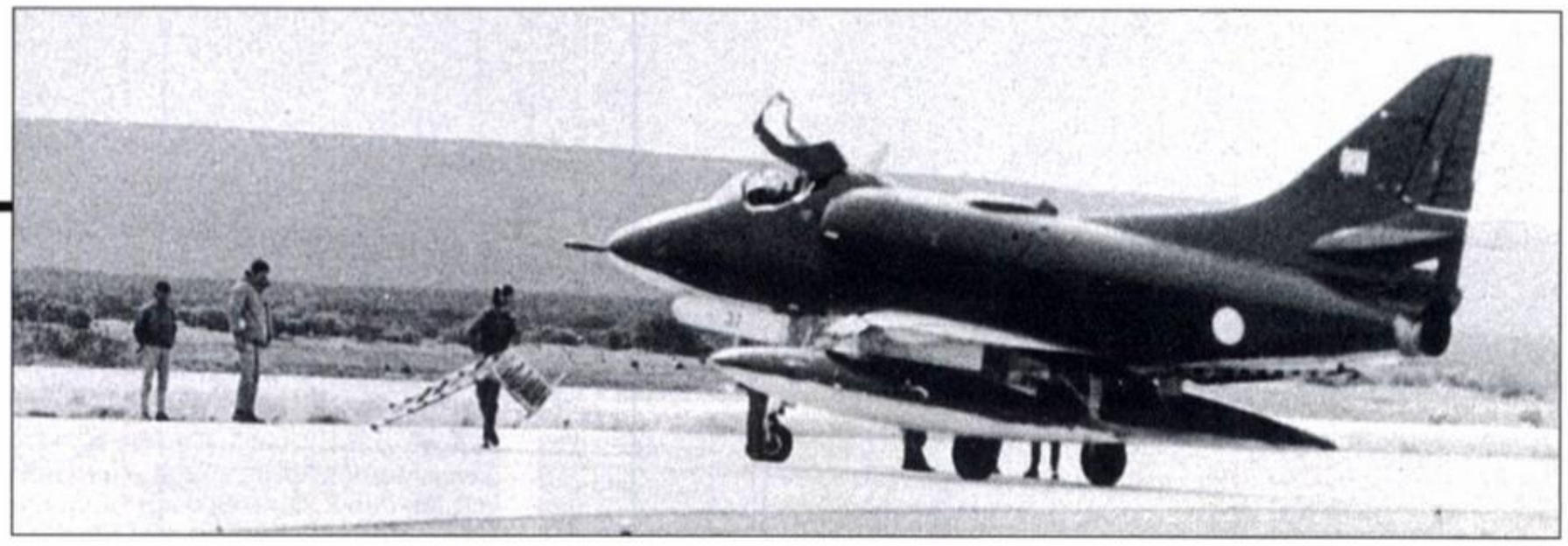
The last days of the conflict were marked by a series of bloody nocturnal battles on the hills to the west of Stanley. Victory was nigh for the British, but the FAA still had one more act to play.

13 June 1982

Last-ditch attack

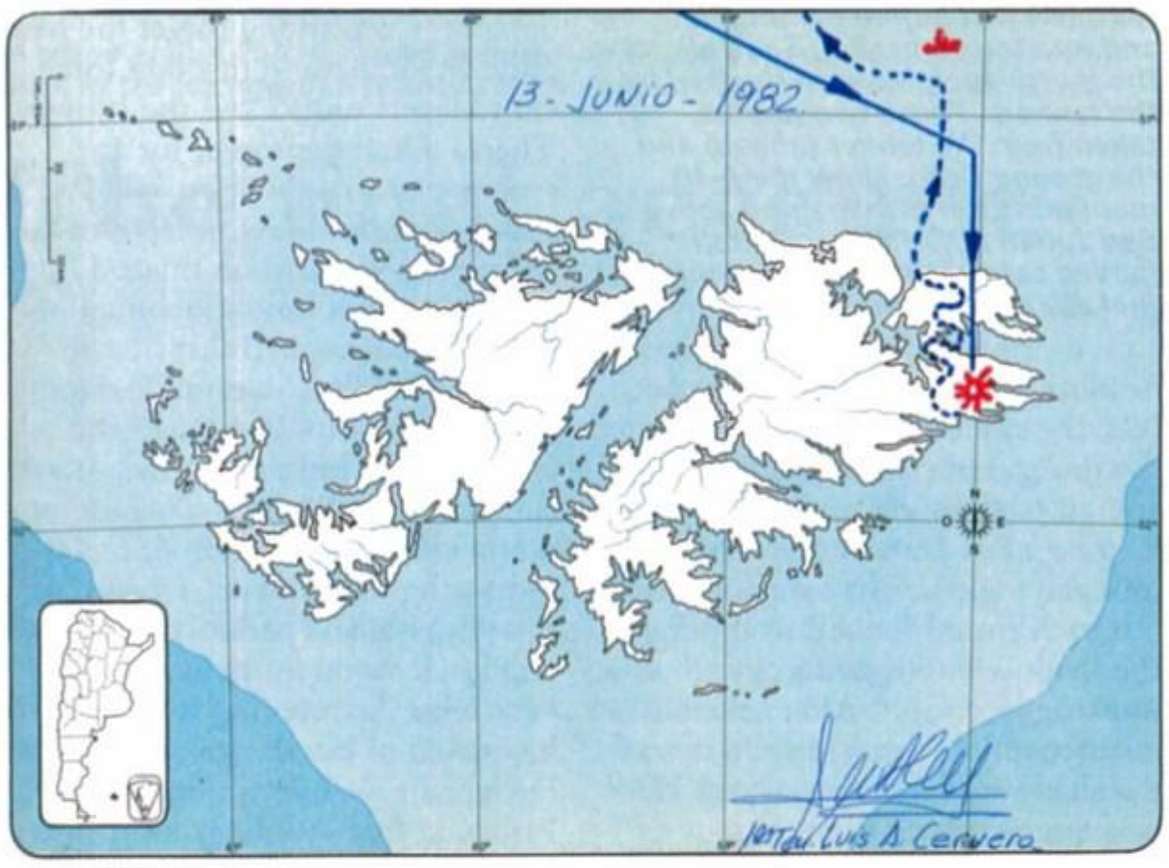
Very few sorties had been flown by the Skyhawks against ground targets, but on the penultimate day of the war, with British forces massed for the final formality of the march into Stanley, CdoFAS launched Grupo 5 on its final mission of the conflict. Teniente Luis Alberto Cervera describes the raid: "The date of June 13 arrived, with two flights at readiness: NENE with Capitán Zelaya, Teniente Gerardi, Teniente

A Grupo 5 A-4B is seen on alert towards the end of the war. The aircraft carries three parachute-retarded 500-lb bombs, the weapons used during the 13 June mission.



Right: A Grupo 5 A-4C prepares to launch on a mission. The unit's final mission was flown from San Julian, rather than Rio Gallegos.

Below: This map shows the route taken by Cervera on 13 June. Ingress/egress routes were largely governed by the locations of the Sea Harrier CAPs.



Cervera [me] and Alferez Dellepiane, and CHISPA with Capitán Varela, Teniente Roca, Teniente Mayor and Alferez Moroni. While waiting in the pilots' room, we were informed that we would make the first and only close air support (CAS) mission for Grupo 5 de Caza during the entire war. We had to attack a British troop concentration and HQ area near Two Sisters. Once all details for this mission were co-ordinated, each one of us went to his Skyhawk. I clearly remember the serial of mine, C-212.

"I did the external walkaround, while the ground crews and armourers wished us good luck. My flight was launched first, except for Alferez Dellepiane who had to take the spare aircraft due to a technical malfunction during the engine start-up of his original A-4. He took off slightly later, with Capitán Varela's flight. During the leg to the AARCP my thoughts were on my family, for this was the only time on a mission when I could allow my attention to wander.

"Under absolute radio silence we began refuelling from the KC-130H. I saw that our flight leader Capitán Zelaya, without topping up his tanks, had disengaged violently from the basket and started a steep descent. Breaking radio silence, I asked him if he had any trouble, and his reply confirmed my fears. His engine temperature gauge was on the red due to fuel ingestion by the compressor, caused by a leak in the refuelling system. Under these conditions he could not continue the mission and had to return to base, so I took the lead from him.

"At this moment, Capitán Varela, CHISPA's flight leader, suggested that he become the leader of the mission due to his greater experience. He led our attack, and I positioned myself 12-15 seconds behind his flight, the best distance to avoid the blast from their bombs. After the refuelling operation we started to descend, maintaining visual contact with CHISPA and checking in the Omega navigation system that we were on the correct route.

"The descent was difficult due to several cloud layers in the area. When CHISPA went through them I lost the Skyhawks from sight. Transitioning to IFR conditions, we passed through the mass of clouds following their heading and descent rate, and when we emerged I found that the leading flight was forward and below us. We had gone through five cloud layers. Once flying low over the water, it was very easy to keep CHISPA within visual contact, as they flew so low that the exhaust from their jet pipes produced a remarkable trail on the ocean's surface, as if they were offshore boats. It was really impressive to see them so low.

"We arrived to the northwest of West Falkland/Gran Malvina. Flying over land by then, we heard our radar controller at Port Stanley calling 'Is anybody flying?', to which both flight leaders replied, giving course and details about the target we intended to attack. The controller gave us valuable information concerning the location of Sea Harrier CAPs. One was flying over Fitzroy, and the other two were flying over the northern and southern ends of the Falklands Sound, so we learned that we were restricted in our possible escape routes after the attack.

"Studying the situation, I suggested to Capitán Varela that perhaps it would be a good idea to return using the same route that we were following now, knowing that this was not covered by the deadly Sea Harriers. Although it was risky making a 180° turn under the enemies' noses, it was less dangerous than meeting a CAP. He replied affirmatively. We were very near the target, and it was harder to follow CHISPA because heading changes occurred frequently and we lost sight of them sometimes in the rolling terrain. With my attention fully fixed on not losing them, I was quite surprised when I heard Capitán Varela say to his flight, 'Bombs away, go!', and then I saw the explosions of the 12 bombs.

"Feeling bad for my wingmen who perhaps could not follow me, I made a hard turn towards the area were the bombs had exploded, because that's where the target was. During the attack run, I started to fire the Colt Mk 12 cannon as a defensive measure to keep heads down. Near the target I could not see very well due to the smoke and dirt produced by the preceding bombs, but when overflying it I saw four or five helicopters destroyed and people running in every direction. I did not drop the bombs because I thought I could find an intact target [it was learned later that only light damage was caused by CHISPA's bombs]. After getting clear of the smoke and confusion, I saw more helicopters and running troops, so that's where

C-212 was the A-4B flown by Teniente Luis Cervera during the 13 June mission, and is seen here wearing two ship kill marks in recognition of earlier exploits. Cervera was unlucky not to score the A-4's first air-to-air victory during the mission.

A close-up of Dellepiane's Skyhawk moments after landing at San Julian reveals fuel still leaking from the hole in the starboard wing. During the trail from the islands, the A-4 was losing almost as much fuel as it was taking on board from the tanker.

we dropped our bombs.

"During the egress I encountered a Sea King helicopter flying perpendicular to me, from right to left. I had the sight collimated for 260 mils – for low-level bombing – so I started to shoot my guns by eyesight, seeing the streak of tracers converging into the big helicopter. I came dangerously close to the Sea King and could clearly see the light blue helmets of the pilots, then with my ammunition spent I pulled up and passed over it, as if in slow motion. [This was a Sea King HC.Mk 4 of No. 846 Sqn, and the only damage was a hole in a rotor blade caused by a 20-mm round. A precautionary landing was made and, after changing the blade, the helicopter was again in the air.]

"After this manoeuvre, and when I had levelled my Skyhawk, I heard Alferez Dellepiane desperately call, 'Tucu, break right! Break right!' I did immediately, putting 90° of bank trying to do the turn as tightly as possible, while at the same time I jettisoned all external stores, drop tanks and multiple ejector racks. Simultaneously, I saw a pair of missiles with a bright flame on their rear ends pass very close to my left side, fast as hell. While in the panic turn, and after releasing the stores, the A-4 skidded down so that only a few feet separated the hard ground from my right wingtip. In such a situation I had no alternative but to put wings level, relaxing the turn and gaining some space to make a safer get-away.

"From then I did not see any more of my wingman during the rest of the flight. I felt uneasy about this, for during the return leg we needed each other for mutual support. While continuing with the escape, I didn't stop swivelling my

Alferez Dellepiane was lucky to survive the 13 June mission when his Skyhawk suffered major damage during the attack on Mount Kent. He managed to hook up to the KC-130H just before flaming out, and was towed back to San Julian, the fourth such 'save' performed by the tankers. These two photos, taken from the tanker (above) and the ground (left), show the A-4B moments after disengaging above San Julian airfield. The aircraft landed safely, although spewing fuel at a prodigious rate.

head from side to side to clear my rear. To my surprise, I noticed over the ground the shadow of an aircraft to the right and rear. I took it to be a Sea Harrier and started to jink and make evasive manoeuvres, but each time I looked to the right the shadow continued in its implacable pursuit. After several more manoeuvres, I realised it was the shadow of my own aircraft! It was quite embarrassing, but given the high stress level I was in at the moment, it was perhaps a logical reaction. All my clothing under the anti-exposure suit was wet from perspiration, so I made an effort to get my adrenaline down to its normal level.

"I went over the beach to the northeast of East Falkland, putting the trusty Skyhawk very low over the ocean, while I continued to scan the rear hemisphere for any Sea Harrier CAPs. When I became convinced that I was alone I tried to pay more attention to the navigation, and then I noticed that I only had 2,000 lb of fuel remaining, when the minimum for a safe base return was 1,900 lb.

"Just after starting my climb to the optimum cruise height, I noticed a frigate at right angles to my flight path; it was as if the warship had risen from under the sea, because I should have seen it before. Without losing it from view, I made an easy left turn until I was parallel with the ship, trying to observe any possible missile launch. Incredibly, there was none. When I thought that separation was sufficient, I started to climb again, and at 10,000 ft I entered clouds. I left them above 30,000 ft and continued the climb until I reached 45,000 ft. Once level, I settled the throttle at 'Bingo' power, to save fuel, as I thought I would not reach San Julian. I had hoped for an aerial refuelling but this proved vain, as Alferez Dellepiane had been hit in one of the wing tanks. He had to be 'towed' by the KC-130H to the airfield, so I elected to leave both drogues to him. In fact, he engaged one of the baskets when the fuel gauge was reading zero.

"At about 110 miles from San Julian, flying at 45,000 ft and with 300 lb of fuel remaining, I put the throttle to idle and started a gentle descent. I was trying to get the best glide angle, passing through three cloud layers until I saw the runway. Then I asked the tower for an emergency straight approach. At about 10 miles I saw in front of me another A-4B, also on finals. I asked this pilot how much fuel he had; Moroni replied that he had about 1,000 lb, and upon learning of my difficulties he cleared the area, performing a 360° turn to land after me. Thus, I touched down safely with 100 lb of fuel remaining in the tanks. I taxied to the dispersal and turned off the engine. I stayed in the cockpit, very tense, wondering what had happened to my wingman Alferez Dellepiane. While waiting for him I noticed that several ground crews had gathered around my Skyhawk and were talking among themselves. I asked myself what the cause could be of their curiosity about C-212. Then the KC-130H Hercules appeared with Dellepiane in tow. After a short final he disengaged and landed; when the wheels touched the runway, a cloud of spraying fuel covered the aircraft. Dellepiane stopped the Skyhawk on the runway and quickly vacated it in case of a fire.

"Now I was much more relaxed, thanks to the mission's happy ending. Climbing down from the cockpit I could observe in the vertical fin four holes, which unbelievably had gone through without touching the hydraulic lines. I joined all the pilots of the two flights and we were very, very happy to be alive. Although we didn't know it at the time, ours was the last Grupo 5 combat mission of the war."

Although the raid caused no damage to the British, the results could have been very, very different. The Skyhawks certainly surprised the troops, although defence was soon brought to bear. NENE flight's bombs had landed perilously close to the command post of Major General Jeremy Moore, commander of British land forces, who was in conference with his key officers at the time, planning the final land action. On the following day, 14 June, General Moore accepted the Argentinean surrender. The Islas Malvinas were the Falkland Islands once more.

A scene at San Julian shows bombed-up Grupo 4 A-4Cs near the end of the war. In the background is an A-4B, recently moved in from Rio Gallegos.

The final account

Undoubtedly the most successful aircraft from the Argentinean point of view, the nimble A-4 achieved the complete loss of a destroyer, two frigates, a landing ship and a landing craft. Additionally, the A-4 caused damage of greater or lesser degree to another destroyer, two frigates and two landing ships. Had more bombs exploded upon hitting the target, the toll taken of British shipping would have been greater.

The price paid was high. From available records it appears that a total of 48 Skyhawks (26 A-4Bs, 12 A-4Cs and 10 A-4Qs) was committed to the Falklands/Malvinas conflict, of which 22 were lost. Eight of these fell to the deadly Sea Harrier, while another seven fell to ship-launched SAMs. Four were lost to artillery/ground-launched SAMs, including one 'friendly fire' incident. The remaining three all flew into the ground or the sea, of which one was during an anti-SAM manoeuvre. Most worrying was the fact that of these 22 losses only four involved a successful ejection. This was partially due to the extreme low level at which the Skyhawks made their attack runs, giving the pilot little chance to escape after being hit.

Skyhawk losses (in chronological order)

9 May – A-4C/Grupo 4 C-313: crashed into high ground at South Jason Island (northwest of West Falkland); Teniente Casco killed
9 May – A-4C/Grupo 4 C-303: crashed into the ocean in bad visibility near South Jason Island, northwest of West Falkland; Teniente Farias killed
12 May – A-4B/Grupo 5 C-246: shot down by Sea Wolf SAM from HMS *Brilliant* off Port Stanley; Primer Teniente Bustos killed
12 May – A-4B/Grupo 5 C-208: shot down by a Sea Wolf fired from HMS *Brilliant* off Port Stanley; Teniente Ibarlucea killed
12 May – A-4B/Grupo 5 C-206: crashed into the sea off Port Stanley while attacking HMS *Glasgow* and HMS *Brilliant*, due to hard evasive actions while avoiding Sea Wolf SAMs; Teniente Nivoli killed
12 May – A-4B/Grupo 5 C-248: shot down (by mistake) by Argentinean 35-mm AA fire over Goose Green; Primer Teniente Gavazzi killed
21 May – A-4C/Grupo 4 C-325: shot down over West Falkland by Sea Harrier of No. 800 Sqn flown by Lt Cdr Blissett; Primer Teniente Manzotti killed
21 May – A-4C/Grupo 4 C-309: shot down over West Falkland by Sea Harrier of No. 800 Sqn flown by Lt Cdr Thomas; Teniente López killed
21 May – A-4Q/3 Eslla 0660/3-A-307: shot down by AIM-9L fired by Lt Morrell in Sea Harrier over Falkland Sound after attacking HMS *Ardent*; Capitán de Corbeta Alberto Jorge Philippi ejected
21 May – A-4Q/3 Eslla 0667/3-A-314: shot down by cannon fire over Falkland Sound by Sea Harrier of Flt Lt Leeming; Teniente de Fregata Gustavo Marcelo Marquez killed
21 May – A-4Q/3 Eslla 0665/3-A-312: damaged over Falkland Sound by Sea Harrier cannon fire (Lt Morrell); Teniente de Navio Jose Cesar Arca attempted to land at Port Stanley but undercarriage damage forced him to bail out; A-4 continued to fly on and was downed by Argentinean AAA
23 May – A-4B/Grupo 5 C-242: shot down by SAM/AA/small arms fire in San Carlos Water while attacking the frigate HMS *Antelope*; Primer Teniente Guadagnini killed
23 May – A-4Q/3 Eslla 0659/3-A-306: bombs hung up during attack on HMS *Antelope*; on return to Rio Grande Capitán de Corbeta Carlos Zubizarreta attempted to land but veered off the icy runway after failing to engage the emergency arresting gear; Zubizarreta ejected but seat failed to work properly and he died from his injuries; aircraft damage light
24 May – A-4C/Grupo 4 C-305: shot down by AA fire and crashed in King George Bay, West Falkland; Teniente Bono killed
25 May – A-4B/Grupo 5 C-244: shot down by Sea Dart SAM from HMS *Coventry* north of Pebble Island; Capitán Palaver killed
25 May – A-4C/Grupo 4 C-319: shot down over San Carlos Water by AA fire and Rapier SAM; Teniente Lucero ejected
25 May – A-4C/Grupo 4 C-304: shot down by Sea Dart SAM from HMS *Coventry* north of Pebble Island; Capitán García ejected but later died of exposure
27 May – A-4B/Grupo 5 C-215: shot down by 40-mm Bofors AA fire from HMS *Fearless* after successfully attacking British positions at Ajax Bay; Primer Teniente Velasco ejected near Port Howard, West Falkland
30 May – A-4C/Grupo 4 C-301: shot down east of the Falklands by Sea Dart SAM from HMS *Exeter*; Primer Teniente Vázquez killed
30 May – A-4C/Grupo 4 C-310: shot down east of the Falklands by Sea Dart SAM from HMS *Exeter*; Primer Teniente Castillo killed
8 June – A-4B/Grupo 5 C-226: shot down over Choiseul Sound by a No. 800 Sqn Sea Harrier flown by Flt Lt Morgan; Teniente Arraras killed
8 June – A-4B/Grupo 5 C-228: shot down over Choiseul Sound by a No. 800 Sqn Sea Harrier flown by Flt Lt Morgan, just after scoring a direct bomb hit on the landing craft *Foxtrot-4* from HMS *Fearless*; Alferez Vazquez ejected but killed
8 June – A-4B/Grupo 5 C-204: shot down by a No. 800 Sqn Sea Harrier flown by Lt Smith over Choiseul Sound; Primer Teniente Bolzán killed

Skyhawks post-war

Eighteen months after the war, the diminishing Fuerza Aérea Skyhawk assets were consolidated within Grupo 5 de Caza when Grupo 4 transferred its seven surviving A-4Cs on 15 December 1983, and in turn re-equipped with ex-IDF/AF Mirage IIICJs and BJs. Limited upgrades were undertaken, mainly in the nav/attack system, providing capabilities to carry a wider variety of bombs, as well as Shafrir or Magic IR-guided AAMs. After 30 years of operational service, the surviving airworthy A-4Bs and Cs (12 Bs and four Cs) were phased out of service in the late 1990s. Grupo 5 de Caza started to re-equip in October 1997 with the first of 36 upgraded ex-USMC A-4M Skyhawk IIs, fitted with APG-66(V)2 radar and known as the A-4AR Fighting Hawk.

After the Falklands War had ended, the navy's 3ª Escuadrilla lost its front-line commitment and became an operational training unit, qualifying pilots in fast jet and carrier operations. The unit disbanded late in 1987, due to a scarcity of aircraft – there were only five A-4Qs available, 3-A-301, -302, -304, -308 and -309. These Skyhawks continued flying for about six months more, until finally being phased out of service and withdrawn from the inventory. The last A-4Q flight was in 3-A-302 in April 1988.

Salvador Mafé Huertas and David Donald

Below left: Soon after the war both A-4Bs and A-4Cs were concentrated in Grupo 5, which continued to fly the elderly Skyhawks until modernised A-4Ms arrived in 1997. Several new colour schemes were applied to Grupo 5 aircraft.

Below: Deck crew prepare an A-4Q for launch from 25 de Mayo after the war. The carrier was retired from service in the 1990s, although CANA aircraft made occasional trips aboard the Brazilian carrier Minas Gerais.

Through his work as chief designer of the Hansa-Brandenburg company during World War I, Ernst Heinkel had gathered significant experience in the design of floatplanes, which he continued through his own company's He 51, He 59, He 60, He 114 and He 115. It was therefore a logical decision to produce one of the He 119 prototypes as a seaplane, and this became the most photographed of the aircraft. The drag penalties of the floats, extra tail area and access ladders affected the performance only minimally, while internal fuel load was reduced to 1600 kg (3,527 lb) from 1750 kg (3,858 lb) to cater for the additional weight of the floats. Nevertheless, range remained an impressive 2430 km (1,510 miles).

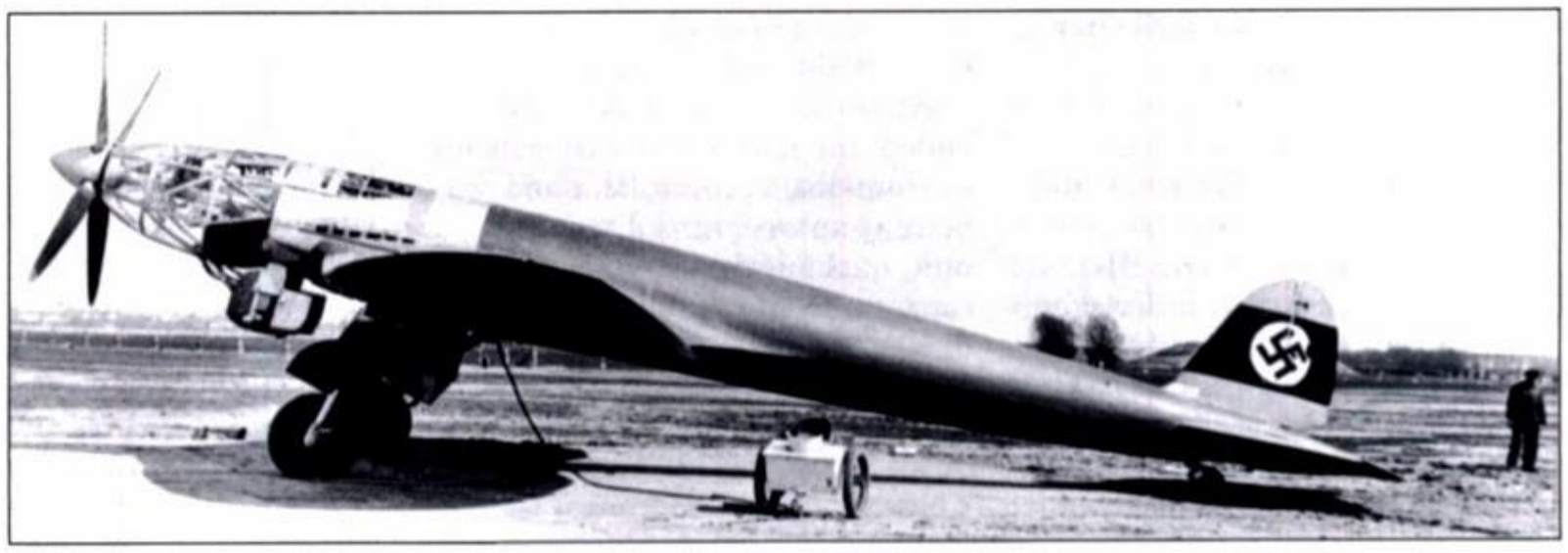
An Industry of Prototypes

Heinkel He 119

Towards the end of World War II, the German aviation authorities gave their blessing to many bizarre concepts, so desperate was the Reich to find new weapons to stave off the inevitable defeat at the hands of the Allies. Before the war, however, the Technischen Amt of the RLM was as reticent to embrace any departures from the norm as most of its contemporaries in other nations. This intransigence was to cost Germany a potentially brilliant and invulnerable reconnaissance platform and light bomber in the early years of the war: the Heinkel He 119. It was, however, partially as a result of Ernst Heinkel's reaction to this official attitude that the aircraft came to be built at all.

Siegfried and Walter Günter had already garnered themselves a reputation for producing extremely sleek monoplanes. Their He 70 design had been a milestone in German aviation – a truly world-class aircraft with exceptional speed for its day. The subsequent designs of the brothers followed similar guidelines, with aerodynamic cleanliness being the overriding concern. Their preoccupation found its ultimate expression in the He 119, which emerged as a beautifully sleek 'flying pencil' with graceful semi-elliptical wings.

Heinkel's intention was that the new aircraft would be a high-speed reconnaissance aircraft or bomber. There would be no provision for defensive armament, the aircraft relying on its speed alone to survive. There were no better designers to realise such a goal as the Günter brothers, working under the supervision of Dipl.-Ing. Hertel. Obviously, the aircraft had to be large enough to carry sufficient fuel and bombs/cameras to perform its mission. To achieve the desired speeds (more than 480 km/h; 300 mph) a twin-engined aircraft was required, but to cut down the drag caused by two large engines Heinkel came up with a then-novel idea: burying the engines within the fuselage structure. After technical meetings with Daimler-Benz had shown that this was feasible, detail design work began.

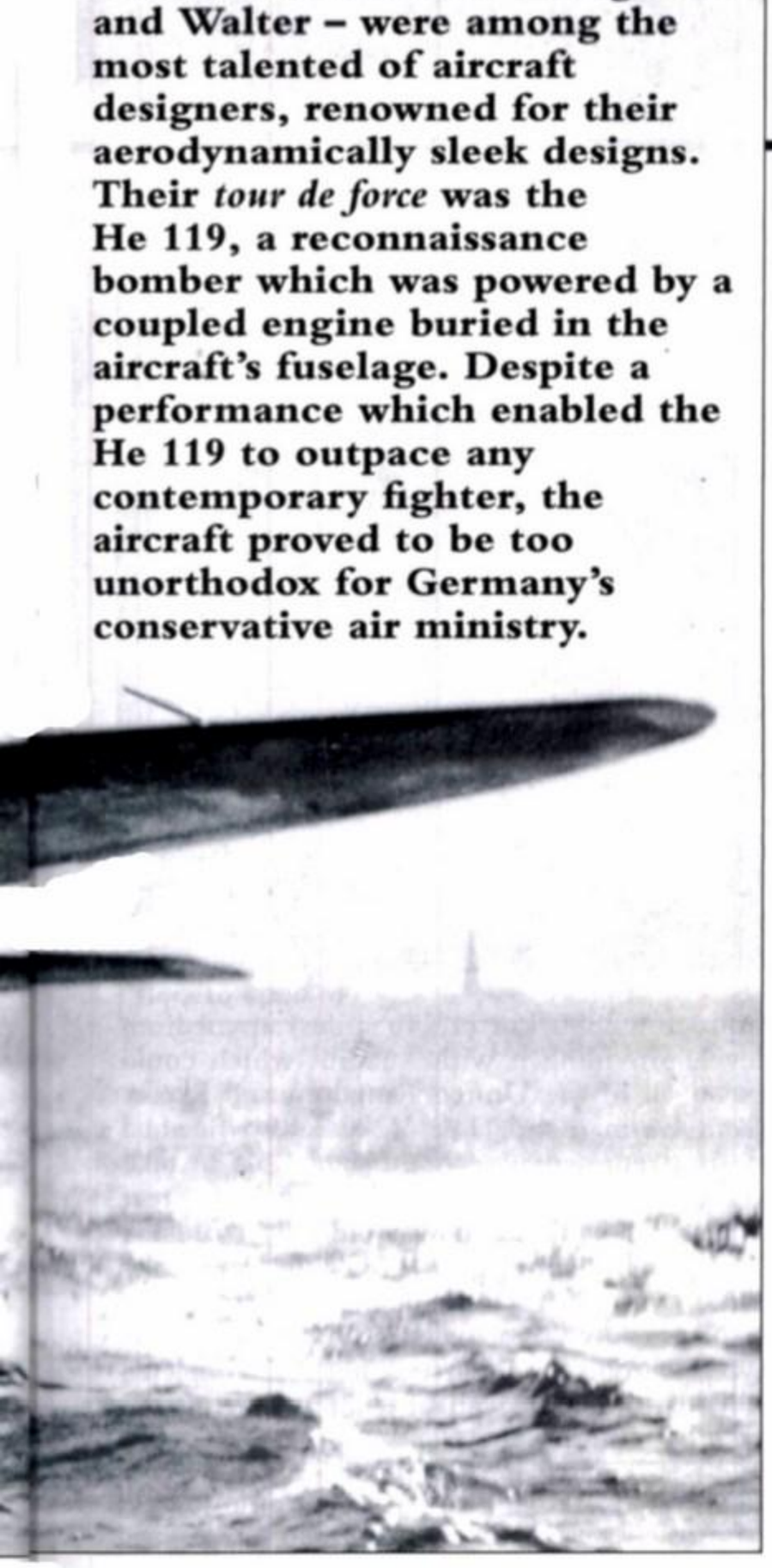


For its initial flight tests the He 119 V1 was completely unarmed, and did not have a rear compartment for a radio operator. The most notable feature was the rudimentary fixed radiator bath added to aid low-speed cooling.

Coupled engines

Power was to be provided by two Daimler-Benz DB 601 engines mounted side-by-side in the central fuselage, as close to the centre of gravity as possible. The Vee-12 engines were inclined so that the cylinder rows almost formed a 'T' arrangement. The crankshafts of each engine were connected to a common hollow shaft which extended forwards to drive a massive four-bladed variable-pitch propeller of 4.27-m (14 ft) diameter. The coupled engine was designated the DB 606A-1, and it provided 2,350 hp (1753 kW) for take-off. To minimise frontal cross-section, a surface evaporation cooling system was employed rather than conventional radiators, steam being pumped under the wing skin of the centre-section where it condensed back to liquid before being returned to the engine cooling system. This concept had hitherto only been applied to high-performance racers such as the Schneider Trophy competitors.

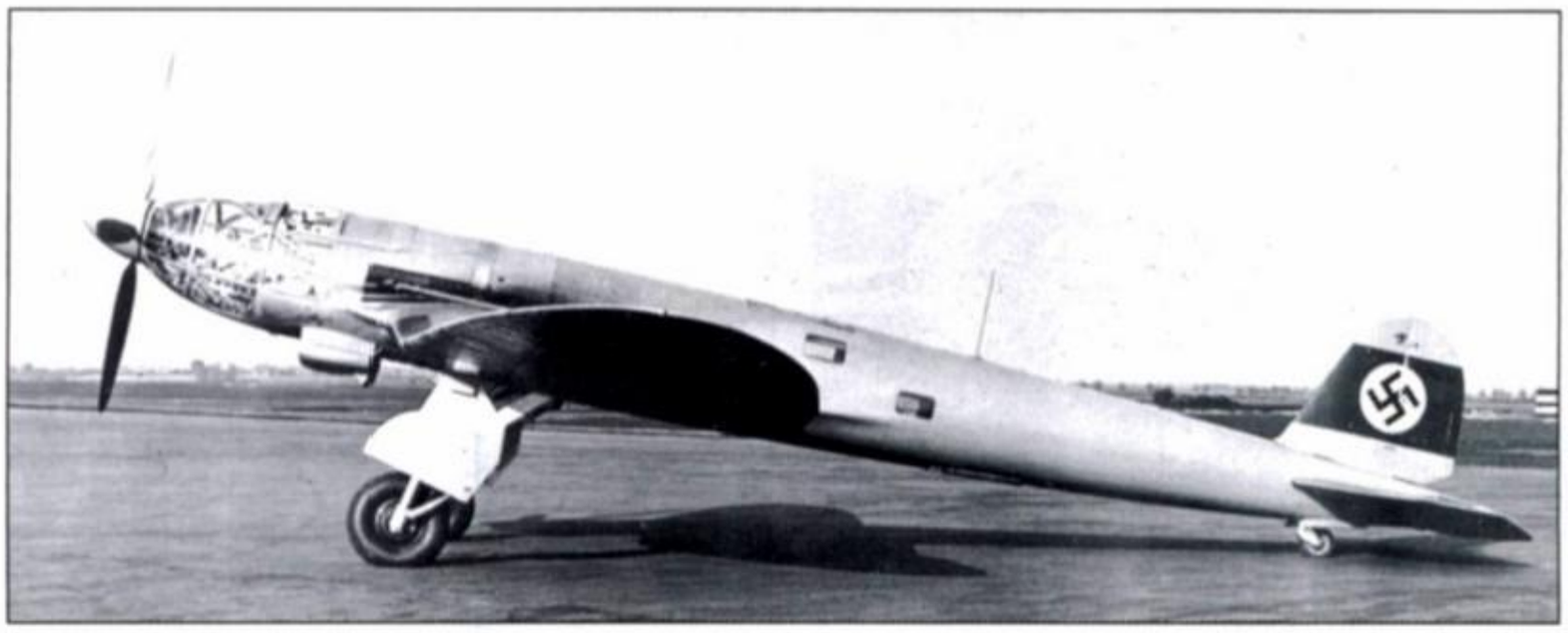
The Günter brothers – Siegfried and Walter – were among the most talented of aircraft designers, renowned for their aerodynamically sleek designs. Their *tour de force* was the He 119, a reconnaissance bomber which was powered by a coupled engine buried in the aircraft's fuselage. Despite a performance which enabled the He 119 to outpace any contemporary fighter, the aircraft proved to be too unorthodox for Germany's conservative air ministry.



To maintain the fuselage streamlining, there was no traditional stepped cockpit. The two pilots sat in the forward fuselage which was provided with glazed panels rather than conventional skinning, giving them both superb visibility. Many of the instruments were mounted on the propeller shaft to maintain the good view outside, and the shaft was also used to mount an unorthodox sliding control column. Throttle levers and other instruments were mounted on a panel above their heads. Entry was effected via two sliding roof panels above each seat.

To cater for operational requirements, provision for a sizeable bay was incorporated just aft of the wing spar, able to accommodate bombs or large cameras, and in the aft fuselage was a compartment for a radio operator and a ventral bay for cameras. For the wings, Siegfried and Walter Günter initially looked no further than the semi-elliptical planform and inverted-gull layout which they had designed for the He 70 and He 112B. The large propeller required considerable ground clearance, which in turn meant long undercarriage struts. Traditional units would have been too long to fit into the wingroot bays from their hinge point at the nadir of the inverted-gull, so they were made to telescope as they retracted in order to fit the available space. The tailwheel was fully retractable and covered by doors.

Mindful of official reaction, Ernst Heinkel kept his new aircraft a closely-guarded secret. It was a private venture, circumventing the need to fulfil an official specification, and all design work was done in secret. Only when the time was right would the aircraft be revealed to the authorities, as a *fait accompli*. Heinkel had such faith in his team's creation that he authorised the construction of no fewer than eight prototypes. Construction work began in the autumn of 1936, in a guarded hangar at the company's Rostock-Marienehe plant. By the summer of 1937 the first aircraft was ready for flight test. Early ground running had shown that, not surprisingly, the surface evaporation system could not provide sufficient cooling for ground and low-speed operations. Accordingly, a large conventional radiator was unceremoniously grafted underneath the forward fuselage.



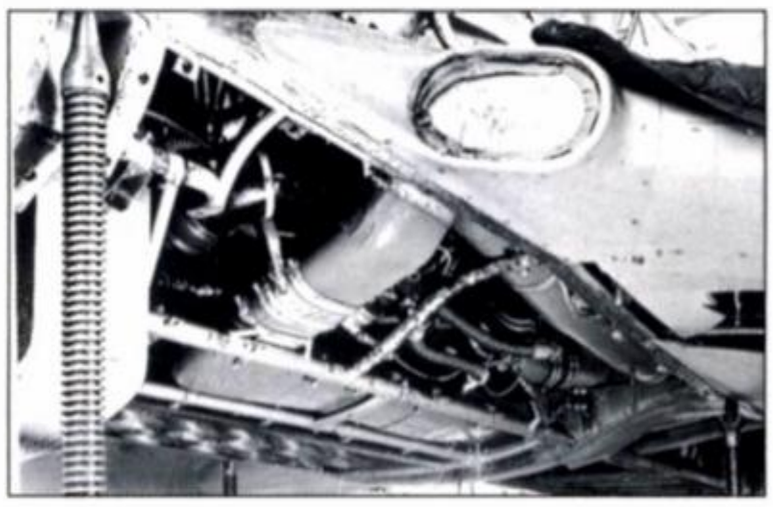
While the V1 undertook its initial flights with the fixed radiator, Heinkel engineers were busy devising a much neater semi-retractable installation, which appeared on the V2. The aircraft also had a rear compartment with provision for a dorsal machine-gun, aft of which was a ventral camera bay.

Into the air

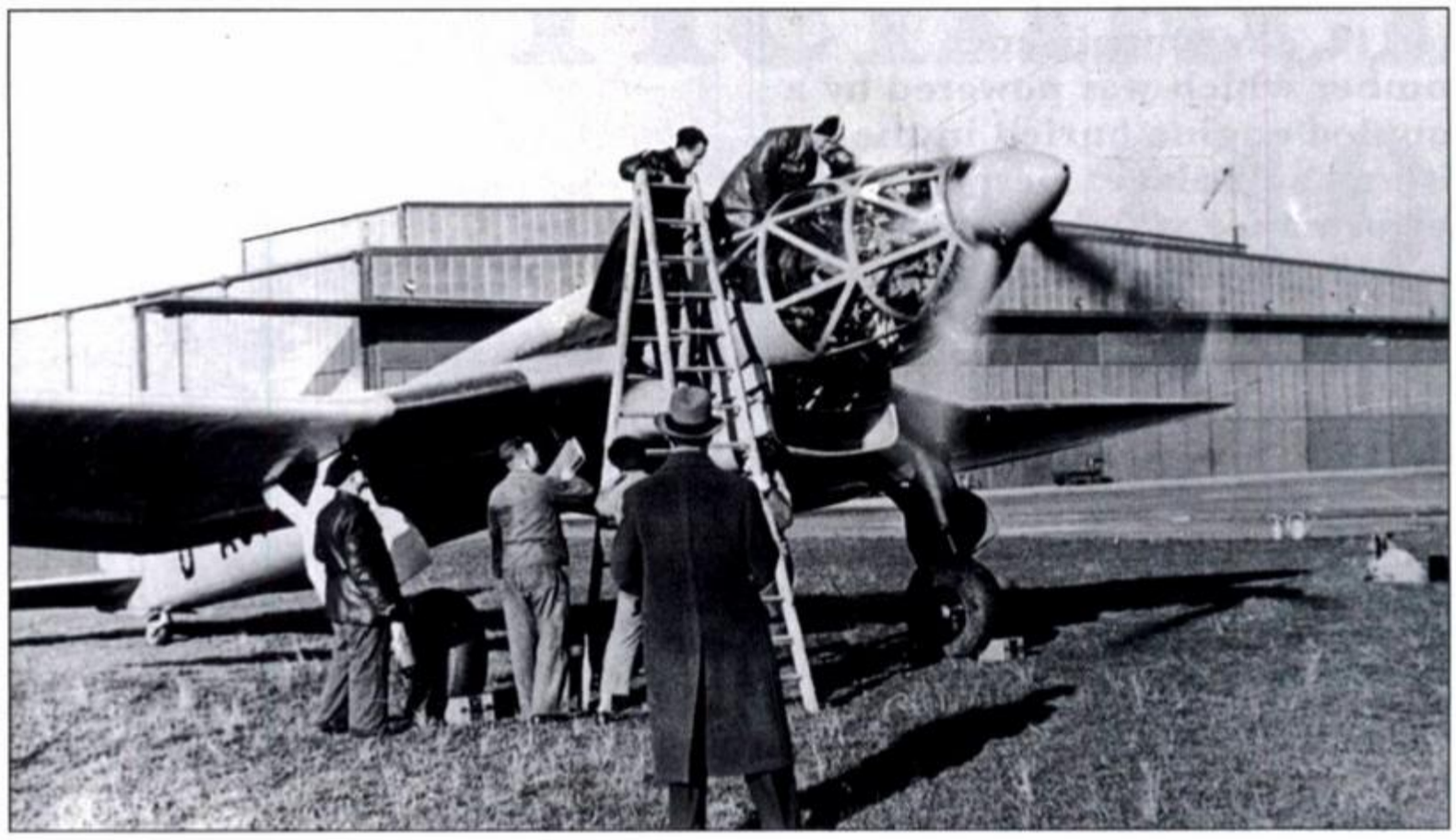
During the summer, Flugkapitän Gerhard Nitschke took the V1 aloft for its first flight, which was accomplished successfully. Despite the ungainly encumbrance of the jury-rigged radiator, initial flight trials demonstrated a top speed of 565 km/h (351 mph). This was by a significant margin faster than any contemporary bomber or, more importantly, any fighter. It was at this point that Heinkel invited a delegation from the Technischen Amt to view the aircraft. Obviously impressed with the phenomenal speed of the type, the traditionalists nevertheless insisted that a bomber could not survive in an unarmed state (although Britain's Mosquito was later to prove beyond all doubt that the concept was feasible), and that defensive armament be added. At this time the official designation He 119 was bestowed on the type.

Despite protestations from Siegfried Günter (his brother having recently died), Heinkel reworked the V1 to feature defensive armament in the form of a pair of 7.9-mm MG 15 machine-guns firing either side of the fuselage from waist positions. Both would be operated

Right: The V2 under construction reveals details of the Doppel-DB 601 (later designated DB 606) installation, the bomb-bay behind it and the retractable radiator. The outboard cylinder rows exhausted above the wings, while the lower rows had stub exhausts mounted side-by-side on the undersides of the centre-section.



Below: From any angle the He 119 breathed high performance, and reality more than matched the aircraft's looks. The first two prototypes (V2 illustrated) had semi-elliptical wings but new, more angular, surfaces were already under development before the first two aircraft flew, and were fitted to the subsequent six machines.



Heinkel employees gather round the V4 as it is prepared for the second speed record attempt in December 1937, which ended in disaster. Gerhard Nitschke was badly injured in the crash (although he recovered sufficiently to resume flying the following year), while co-pilot Hans Dieterle survived with minor injuries. Dieterle later captured the absolute world speed record in March 1939, flying the He 100 V8, although his mark of 463.92 mph was bettered less than a month later by the Messerschmitt Me 209 V1.

by the single rear crew member. This still did not please the Technischen Amt, which insisted on the conventional armament of an upper and lower gun, operated by separate gunners. To cater for this, the V1 was modified yet again, this time with rear-facing MG 15s mounted behind flush-fitting glazed panels. When the guns were deployed, the fairings formed windshields to protect the gunners, although these created considerable drag. It was supremely ironic that the measures stipulated by the authorities for the He 119's defence would effectively rob the aircraft of its natural defence: its high speed.

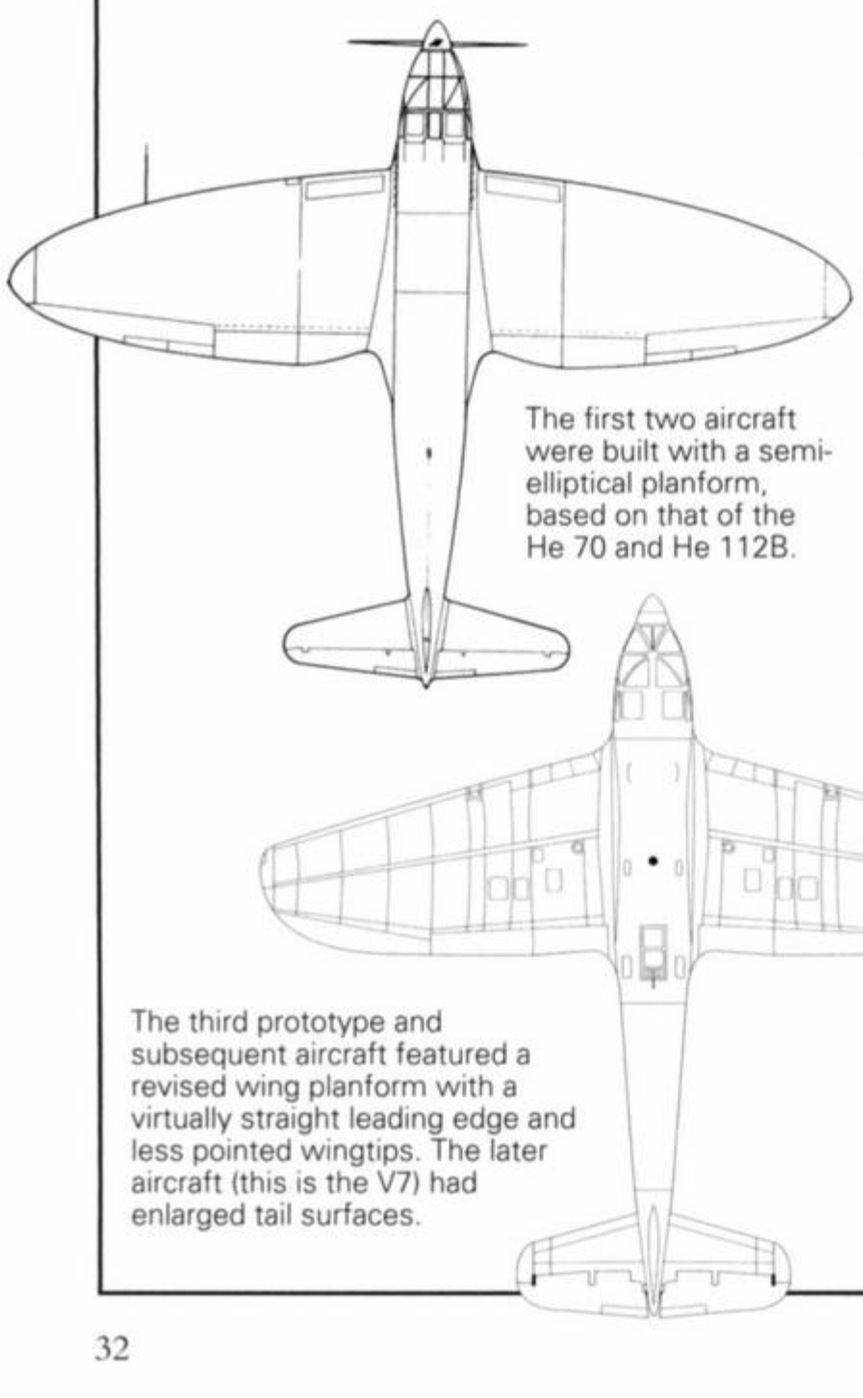
Following the V1 into the air in September 1937, the V2 second prototype incorporated several improvements, not least of which was a much neater semi-retractable radiator, which was fully lowered for ground and low-speed operations but retracted up into the fuselage at higher speeds. The effect on performance was dramatic, top speed rising to 584 km/h (363 mph). Quite clearly a formidable performer, the He 119 V2 could cruise at over 480 km/h (300 mph) for 2800 km (1,740 miles) at medium level, providing it with a radius which could cover all of the United Kingdom and France from German soil. The V2 was also finished with a representative bomb-bay, able to take three 250-kg (551-lb) bombs, and had a rear compartment fitted. It was officially evaluated by the Erprobungsstelle at Rechlin, ironically without its defensive armament fitted.

Next to fly was actually the V4 fourth prototype, D-AUTE, which was initially completed with the principal purpose of capturing the

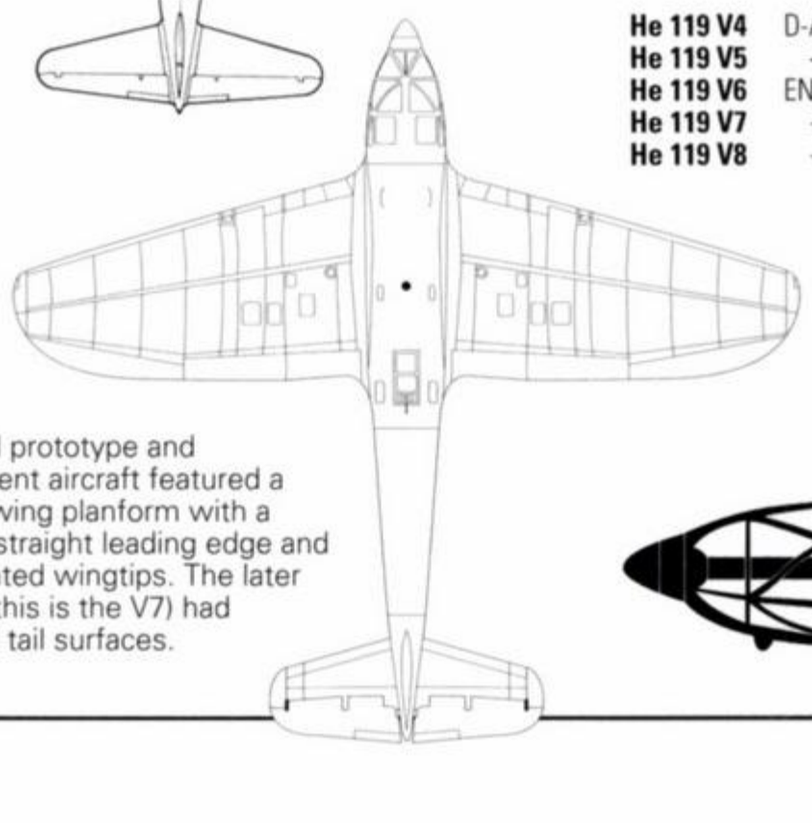
He 119 production and variants

Considerable confusion exists concerning the designations and registrations of the eight He 119 prototypes. The main area of contention is the floatplane D-ADPQ, which has been variously reported as the V3 and the V5. Even the record-breaking aircraft has also been assigned the V3 designation in at least one publication, although most agree that it was the V4. The registration D-ASKR has been quoted for both the second and third prototypes, but the one existing photo of the aircraft carrying the registration clearly shows it with the elliptical wing of the first two aircraft. It is conceivable that a later aircraft was built with this wing, and then modified with the new surfaces, although unlikely. The following table is therefore a 'best guess' and conforms to Heinkel's own sketchy records. It has been used as the basis for the designations and registrations throughout the article.

Prototype	Regn	Role
He 119 V1	–	reconnaissance prototype
He 119 V2	D-ASKR	bomber prototype (also reported as V3)
He 119 V3	D-ADPQ	reconnaissance floatplane (also reported as V5)
He 119 V4	D-AUTE	unarmed reconnaissance; record-breaker
He 119 V5	–	pre-production He 119A (reconnaissance)
He 119 V6	EN+RC	pre-production He 119A (reconnaissance)
He 119 V7	–	pre-production He 119B (bomber)
He 119 V8	–	pre-production He 119B (bomber)

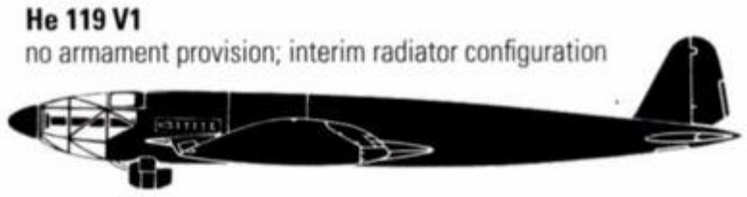


The first two aircraft were built with a semi-elliptical planform, based on that of the He 70 and He 112B.

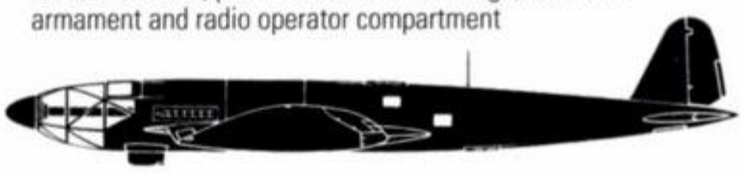


The third prototype and subsequent aircraft featured a revised wing planform with a virtually straight leading edge and less pointed wingtips. The later aircraft (this is the V7) had enlarged tail surfaces.

He 119 V1
no armament provision; interim radiator configuration

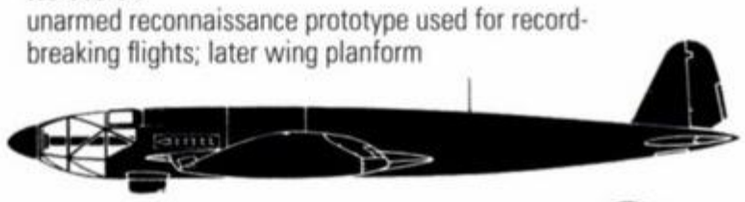


He 119 V2 (final configuration)
revised radiator; provision for bomb carriage; defensive armament and radio operator compartment

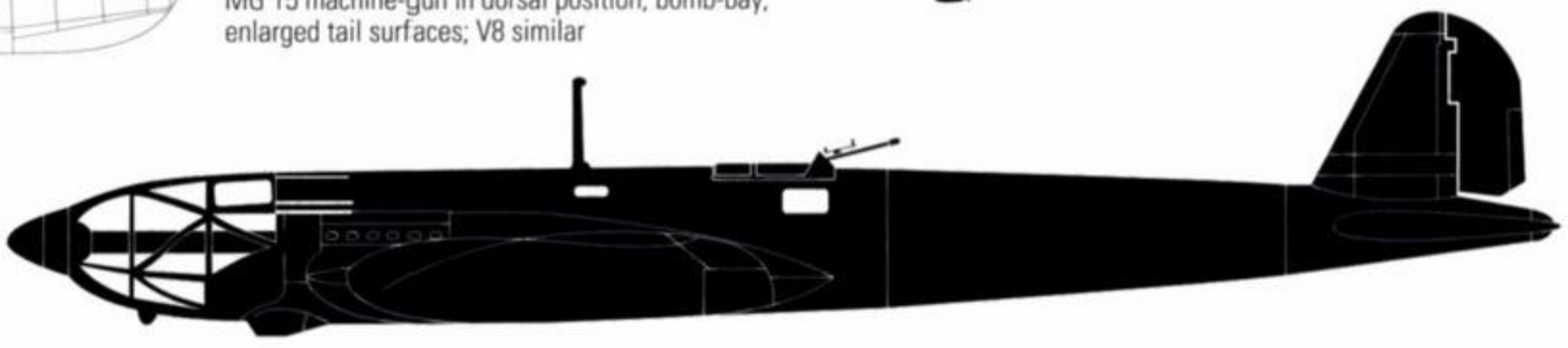


He 119 V3 (possibly V5)
reconnaissance floatplane; later wing planform, enlarged rudder; large ventral fin and dorsal/ventral strakes added

He 119 V4
unarmed reconnaissance prototype used for record-breaking flights; later wing planform



He 119 V7 (below)
He 119B bomber pre-production aircraft; one MG 15 machine-gun in dorsal position; bomb-bay; enlarged tail surfaces; V8 similar



Heinkel He 119 specifications

	V1	V2	V3	V4	V5/V6	V7/V8
span	16.00 m (52 ft 6 in)	16.00 m (52 ft 6 in)	15.90 m (52 ft 2 in)	15.90 m (52 ft 2 in)	15.90 m (52 ft 2 in)	15.90 m (52 ft 2 in)
length	14.80 m (48 ft 7 in)	14.80 m (48 ft 7 in)	15.52 m (50 ft 11 in)	14.80 m (48 ft 7 in)	14.802 m (48 ft 7 in)	14.80 m (48 ft 7 in)
height	5.40 m (17 ft 9 in)	5.40 m (17 ft 9 in)	6.45 m (21 ft 2 in)	5.40 m (17 ft 9 in)	5.40 m (17 ft 9 in)	5.40 m (17 ft 9 in)
wing area	51.60 m² (555 sq ft)	51.60 m² (555 sq ft)	50.00 m² (538 sq ft)	50.00 m² (538 sq ft)	50.00 m² (538 sq ft)	50.00 m² (538 sq ft)
powerplant	DB 606A-1	DB 606A-1	DB 606A-2	DB 606A-2	DB 606A-2	DB 606A-2
power rating (take-off)	1753 kW (2,350 hp)	1753 kW (2,350 hp)	1753 kW (2,350 hp)	1753 kW (2,350 hp)	1753 kW (2,350 hp)	1753 kW (2,350 hp)
power rating (at 3700 m)	1641 kW (2,200 hp)	1641 kW (2,200 hp)	1641 kW (2,200 hp)	1641 kW (2,200 hp)	1641 kW (2,200 hp)	1641 kW (2,200 hp)
empty weight	5160 kg (11,376 lb)	5120 kg (11,287 lb)	5660 kg (12,478 lb)	5200 kg (11,464 lb)	5200 kg (11,464 lb)	5360 kg (11,817 lb)
maximum weight	8000 kg (17,637 lb)	8100 kg (17,857 lb)	8700 kg (19,180 lb)	7160 kg (15,785 lb)	7565 kg (16,678 lb)	8600 kg (18,959 lb)
max speed at sea level	450 km/h (280 mph)	485 km/h (301 mph)	480 km/h (298 mph)	545 km/h (339 mph)	490 km/h (304 mph)	475 km/h (295 mph)
max speed at 4500 m	565 km/h (351 mph)	585 km/h (363 mph)	570 km/h (354 mph)	620 km/h (385 mph)	590 km/h (367 mph)	600 km/h (373 mph)
max speed at 6000 m	530 km/h (329 mph)	555 km/h (345 mph)	540 km/h (335 mph)	585 km/h (363 mph)	570 km/h (354 mph)	550 km/h (342 mph)
cruise speed at 4500 m	450 km/h (280 mph)	490 km/h (304 mph)	480 km/h (298 mph)	550 km/h (342 mph)	510 km/h (317 mph)	475 km/h (295 mph)
maximum range	2410 km (1,498 miles)	3000 km (1,864 miles)	2430 km (1,510 miles)	1410 km (876 miles)	3120 km (1,939 miles)	2700 km (1,678 miles)
service ceiling	8000 m (26,245 ft)	8500 m (27,890 ft)	8000 m (26,245 ft)	9300 m (30,510 ft)	8500 m (27,890 ft)	8500 m (27,890 ft)
take-off run	780 m (2,560 ft)	770 m (2,525 ft)	940 m (3,085 ft)	720 m (2,360 ft)	750 m (2,460 ft)	790 m (2,590 ft)
landing run	630 m (2,065 ft)	610 m (2,000 ft)	610 m (2,000 ft)	640 m (2,100 ft)	660 m (2,165 ft)	630 m (2,065 ft)
time to 2000 m	4.1 minutes	3.2 minutes	4.6 minutes	3.0 minutes	3.1 minutes	4.0 minutes
time to 4000 m	9.4 minutes	6.5 minutes	10.4 minutes	6.3 minutes	6.4 minutes	9.0 minutes
time to 6000 m	15.8 minutes	11.0 minutes	17.2 minutes	10.2 minutes	10.7 minutes	15.0 minutes

world speed record over a 1000-km closed circuit carrying a 1000-kg payload. The aircraft had no armament provision or rear compartment, and was provided with a reduced fuel load (1500 kg/3,307 lb), sufficient for the task. The DB 606A-2 engine was fitted, this providing the same power output as the A-1 but with a lower gear ratio (2.1:1 as opposed to 2.43:1). The main difference lay in the wing planform, which was modified to have an almost straight edge, squarer wingtips, and slightly reduced span and area. The combined effect of these modifications was to produce a top speed of 620 km/h (385 mph).

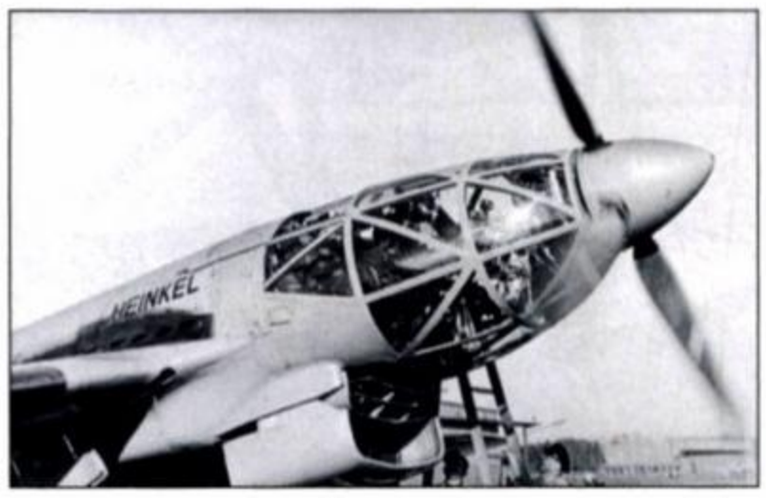
Record attempt

Having first flown in October 1937, the V4 was ready for its first record attempt on 22 November 1937. With Gerhard Nitschke as pilot and Hans Dieterle as co-pilot, D-AUTE took off from Hamburg for an out-and-back trip to Stolp (now known as Slupsk) in Pomerania. Bad weather forced the crew down to low altitude to navigate, with the result that the He 119 was flying at about 800 m (2,625 ft) instead of the planned 4000 m (13,120 ft). The speed record was obtained with an average speed of 504.988 km/h (313.78 mph), also setting records in the 1000-km closed-circuit class for zero payload and 500-kg payload. This was well below expectations, and the record stood for only a week before being taken by the Italian Breda Ba 88 with a speed of 525.1 km/h (326.3 mph).

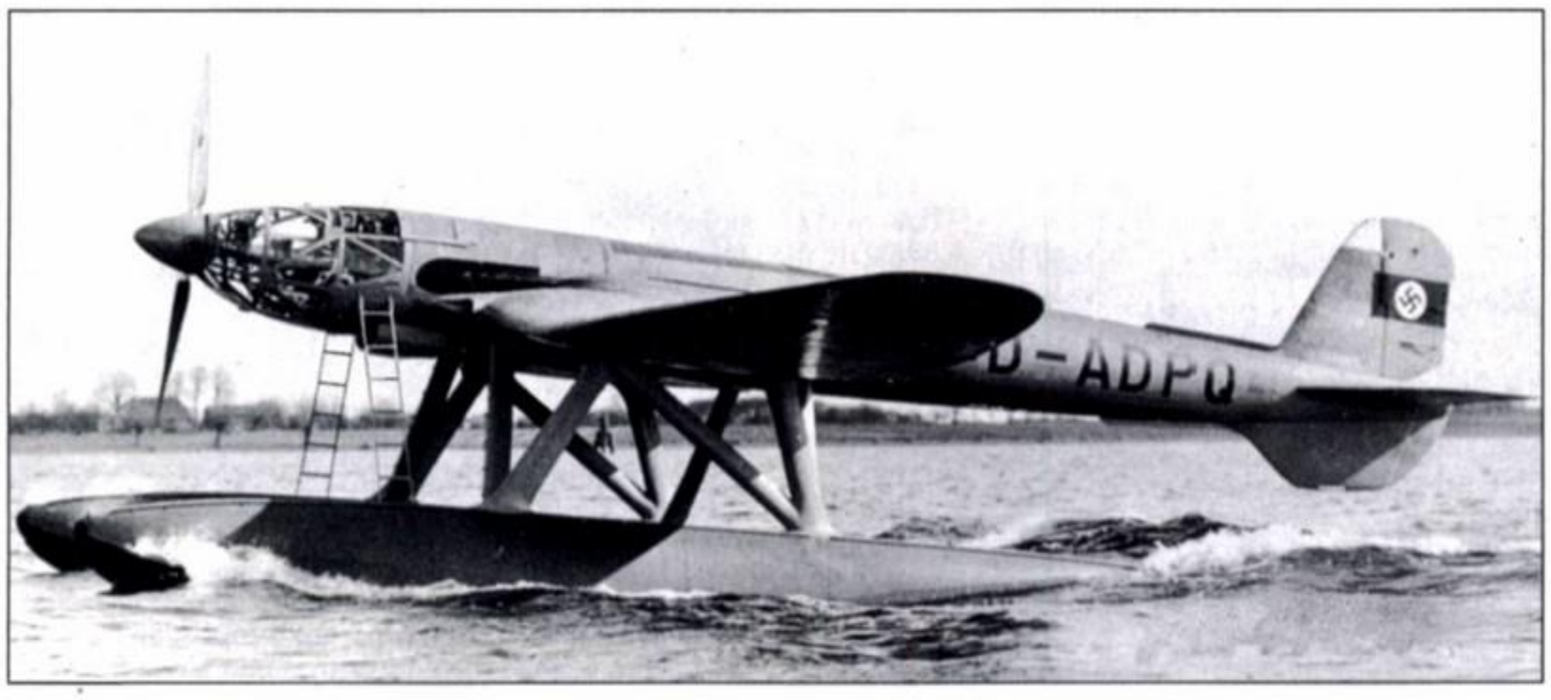
Nevertheless, the Heinkel record sent shock waves through Europe. In the ensuing propaganda the Germans named the aircraft as an 'He 111U bomber'. The He 111 was already well-known as a potent warplane, and a version that was faster than contemporary fighters was indeed a worrisome thought. When the FAI confirmed the record, the aircraft was described as the 'He 606', a play on the engine designation which hid the aircraft's true identity. The mystery was only revealed to the Allies after the end of World War II.

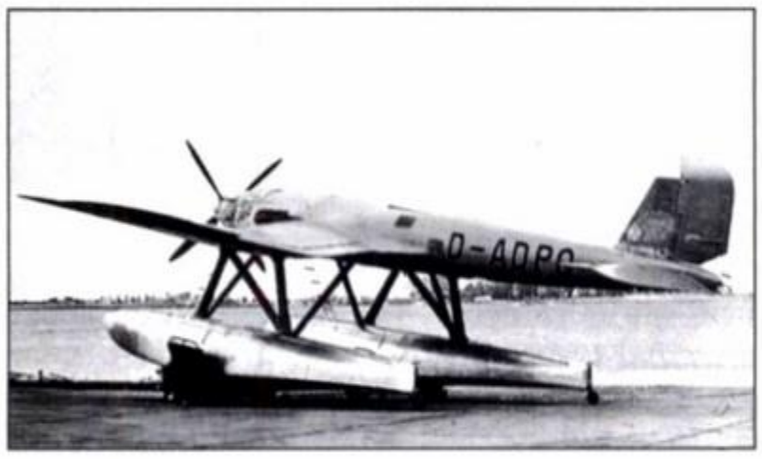
Most bomber manufacturers at the time would have been pleased to have had a 300-mph plus bomber, but the He 119 V4 could perform much better. Heinkel quickly arranged a second record attempt which, it was hoped, would show to the world the true capabilities of the type and provide the Germans with a powerful propaganda weapon. Some time in December, Nitschke and Dieterle set off over the same course, this time with better visibility. Stolp was reached at an average speed of a shade under 595 km/h (370 mph) and all looked good for the flight to smash the Ba 88's record. Shortly after the turn at Stolp, the engine began to misfire and the fuel gauges dropped to empty. The crew prepared to force-land, feathering the propeller and gliding towards Travemünde airfield which lay ahead. The approach was routine, but just as the aircraft was committed to land, the pilots saw some temporary drainage ditches which had been dug across the landing area in the course of airfield maintenance. There was nothing they could do

Right: This close-up of the V4 provides good detail of the forward glazed nose section. Accommodation was a bit cramped, but provided excellent visibility for both pilots, further enhanced by keeping the forward instrument dash to minimal size. The radiator is seen in the extended position: it progressively retracted as the speed increased and the surface evaporation cooling system became more effective.

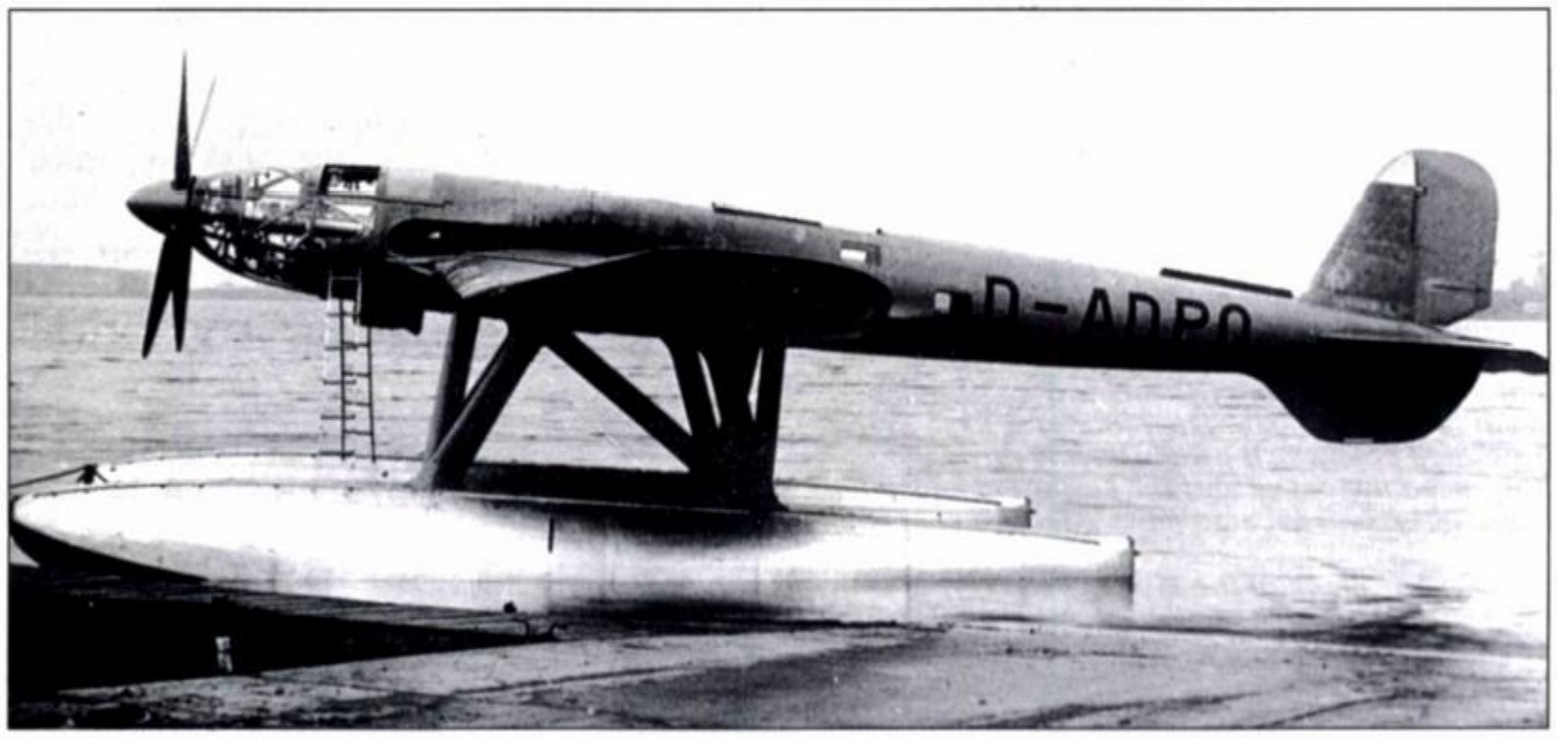


Below: The crash of the He 119 V4 at Travemünde was the end of Heinkel's attempts to gain speed records with the He 119 series, and dealt a further blow to the aircraft's chances of being put into production for the Luftwaffe.





***D-ADPQ** was the sole floatplane prototype, intended to be the progenitor of the He 119C reconnaissance/patrol aircraft. It, too, was intended to set a speed record (1000-km closed-circuit seaplane), but after the crash of the V4 any such attempt was abandoned. Shown here is the aircraft in three configurations, in which the vertical tail surfaces grew incrementally. At right is the initial configuration, with an enlarged rudder (as compared to the landplane), while below is the aircraft with ventral fin and dorsal strake added, both lacking water-rudders on the floats. Above, it has the final-standard 'tail-feathers' with an additional ventral strake.*



but ride the aircraft to its fate. The ditches ripped off the undercarriage, and the aircraft eventually ended up in a sorry state alongside a pumping station, its starboard wing torn off by the building. Both pilots survived the crash, although it took Nitschke nearly a year before he was flying again. The problem was eventually traced to a faulty fuel transfer switch.

Sleek seaplane

Given Heinkel's history of floatplanes, it was no surprise that one of the prototypes was finished with float undercarriage. This was the V3 (also reported as the V5) D-ADPQ, progenitor of the He 119C maritime patrol and anti-shipping aircraft. It had the same wing planform as the V4, and also the DB 606A-2 engine. Initially built with a larger rudder, the aircraft subsequently gained a ventral fin and tail strakes to reach an acceptable level of directional stability. It had a ventral camera bay in the rear fuselage and a working rear compartment with single dorsal MG 15 gun. Offensive armament for the production version would have been three 250-kg (551-lb) bombs.

Looking somewhat incongruous on such a sleek aircraft, two ladders were fixed either side of the cockpit, running down to the single-step floats. The V3 was earmarked for an assault on the 1000-kg payload, 1000-km closed-circuit record for seaplanes, but, following the V4 disaster, Heinkel was forbidden from making any more record attempts. The floatplane was exhaustively tested at Travemünde yet, despite a superb performance, the official view of this unorthodox aircraft remained disdainful.

Heinkel's remaining four prototypes were all completed during the first half of 1938, comprising two reconnaissance-configured aircraft (V5 and V6) and two bombers (V7 and V8). All carried a crew of three, consisting of pilot, co-pilot (who doubled as bombardier) and radio operator in the rear compartment. The latter also operated the single dorsal MG 15 machine-gun. All four were considered as pre-production aircraft for the He 119A (reconnaissance) and He 119B (bomber). The camera platform still retained the ability to carry three 250-kg (551-lb) bombs in its fuselage bay or large cameras, in addition to standard cameras further back in the rear fuselage. It was lighter and better performing than the bomber, which could carry the standard three 250-kg weapons or 16 50-kg (110-lb) bombs at normal weights, or one 500-kg (1,102-lb) and two 250-kg bombs in overload condition.

All four pre-production aircraft were extensively tested at Rechlin in the late summer of 1938 but, as with the seaplane, official suspicion of this unusual aircraft triumphed over the enthusiasm of the test pilots. There were still nagging problems which were never fully overcome, chiefly concerning engine overheating. Another factor in the He 119's demise was that DB 601 engines were in heavy demand for the Messerschmitt Bf 109 and Bf 110, and the Heinkel He 111 bomber. All things considered, the He 119 showed such promise that it is almost incredible that the type was not developed further.

According to the Technischen Amt, by the time the He 119A/B would have been ready to enter service, potential enemy fighters would have advanced to the point that the He 119's speed advantage had been eradicated. As events were to prove, this was simply not the case. The best Allied fighter of the early war years, the Spitfire Mk I/II, could barely manage 565 km/h (350 mph), still some way short of the figure set by the He 119B in operational configuration, and it was not until the advent of the Spitfire Mk V in 1941 that the Allies would have possessed an aircraft which stood a chance of catching an He 119. Many important Allied fighters such as the Curtiss P-40, Dewoitine D.520 and Hawker Hurricane were destined never to attain such speeds.

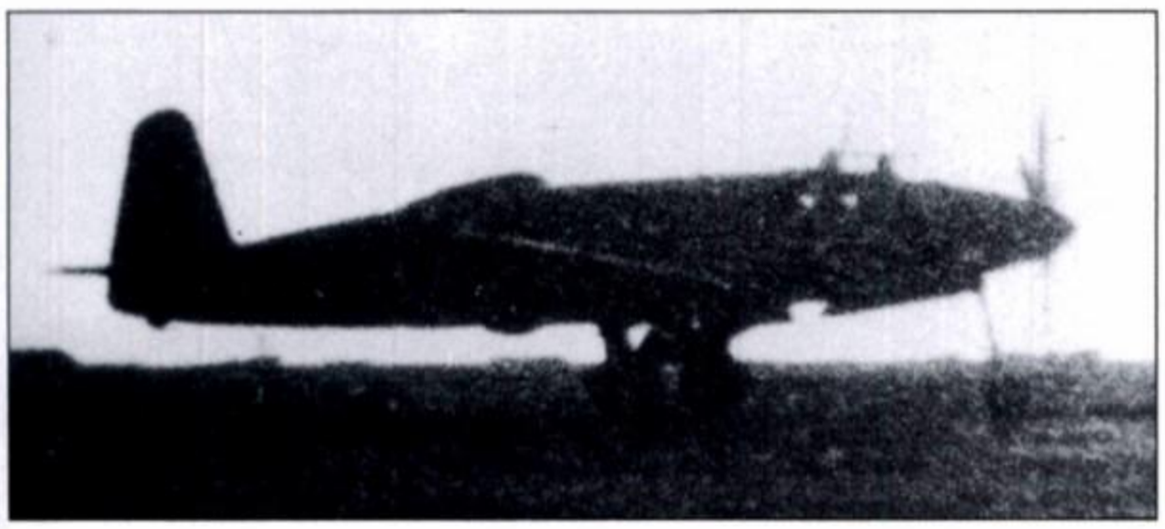
Engine tests and Japanese interest

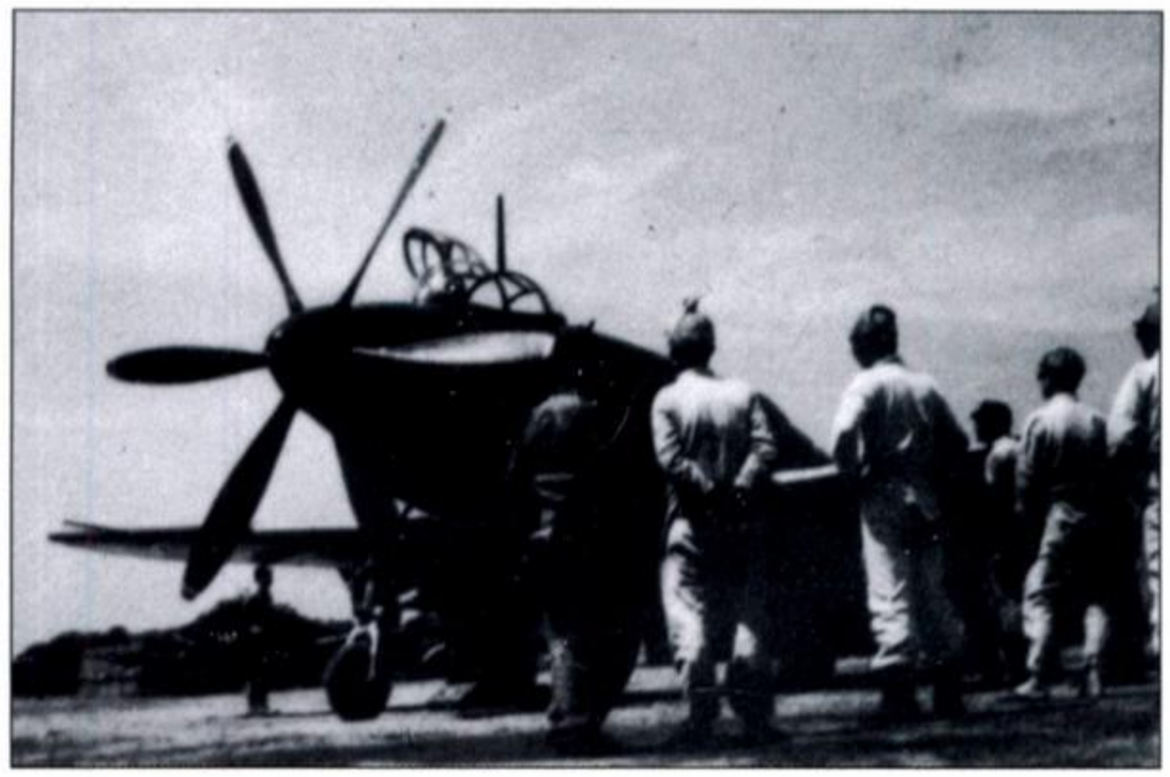
With official interest in the He 119 as a production aircraft fully extinguished, there was little gainful employment for the prototypes other than for test work, which centred on the coupled engine layout. New versions of the DB 606 were tested, as were various DB 610s (a coupled pair of DB 605s). Both of these engines were used in production models of the He 177 Greif bomber, and reached over 2313-kW (3,100 hp) in output. There is no record of how the He 119 performed with one of these brutes.

While the German authorities shunned the He 119, those in Japan became very interested in the type, especially its coupled engines. Following the 1938 Rechlin trials an Imperial Japanese Navy delegation visited the Heinkel works to examine the He 119, leading to the subsequent purchase of the two He 119B aircraft (V7 and V8) and a licence to manufacture the type. A working party from the 1st Naval Air Technical Arsenal at Yokosuka was sent to Heinkel to study the type and, in early 1940, the two prototypes were shipped to Japan for further detailed examination. On arrival in May, they were reassembled at Kasumigaura, with flight trials beginning at Yokosuka. The first Japanese pilot to fly the type was Major Shiochi Susuki. During early flight trials one aircraft was badly damaged in a landing accident. Little is known of the subsequent fate of the Japanese, or indeed the German, aircraft, and no production ensued in either country. The aircraft's influence did live on, however, being the inspiration behind the Yokosuka R2Y1 Keiun. **David Donald**

Yokosuka R2Y1 Keiun

Japan's mid-engined twin





At an early point in World War II the Imperial Japanese Navy identified a need for a high-speed long-range reconnaissance aircraft. Yokosuka began development of the R1Y1 Seiun (blue cloud), also designated Y-30, to answer this requirement. The aircraft was to have been powered by a Mitsubishi 24-cylinder engine developing 1865 kW (2,500 hp). This powerplant was much delayed, and so Yokosuka looked to a pair of Mitsubishi MK10A radials. Projected performance of these engines fell below the specification, and the R1Y1 was cancelled.

In its place, Yokosuka shifted work to the Y-40, serious studies for which began in 1943. This aircraft was inspired by the He 119, and had a similar powerplant of a coupled engine buried amidships, driving a six-bladed propeller via an extension shaft. The engines were normally aspirated by a large airscoop on the spine, and employed conventional cooling radiators rather than a surface cooling system. Oil cooler intakes were located in the wingroots. The powerplant was an Aichi Ha-70-10, essentially two Atsuta 30 engines mounted side-by-side. The Atsuta 30 was itself a development of the DB 601 engine, which Aichi manufactured under licence for the Navy (Kawasaki built it for the Japanese Army as the Ha-40). The installation in the Y-40 would develop 2536 kW (3,400 hp) for take-off and 2313 kW (3,100 hp) for cruise, giving a projected maximum speed of 720 km/h (447 mph) at 10000 m (32,810 ft). A thin aerofoil section wing was mounted low down on the fuselage, and a tricycle undercarriage fitted, the nosewheel retracting beneath the cockpit.

Designated R2Y1 and named Keiun (beautiful cloud), the new aircraft took shape through the summer of 1944, but the Japanese defeat in the Marianas drastically changed Japan's military situation. All design and manufacturing effort was now directed to fighter and bomber production, and as the Allies closed in the need for a long-range reconnaissance aircraft largely evaporated. Yokosuka was told to stop work on the Keiun.

This should have spelled the end for the R2Y1, but the Yokosuka team proposed a jet-powered version for use as a fast attack aircraft. This scheme met with approval, and construction and flight-testing of the piston-engined R2Y1 was continued in order to provide aerodynamic data for the jet-powered aircraft, which was designated the R2Y2 Keiun-Kai. To that end, the first R2Y1 was completed, and on 27 April 1945 was moved to Yokosuka naval air base for taxiing trials. Nosewheel shimmy was the main problem encountered, which took some time to fix. The aircraft was then moved to Kisarazu naval air base, where taxi trials resumed on 8 May. Again nosewheel shimmy surfaced, as did some overheating in the engine bay. Finally, on 22 May (some sources say 7 May), Lieutenant Commander Kitajima (a Pearl Harbor veteran) took the R2Y1 off the ground for a brief straight-line hop. On the following day, Kitajima flew the R2Y1 on its first full flight. During the climb-out, fire broke out in the engine bay, forcing Kitajima to feather the propeller and return hastily to the field.

Above: This poor photograph provides some idea of the general layout of the R2Y1. A tricycle undercarriage was adopted from the outset of design work, the central engine installation providing more than enough room to house a retractable nosewheel.

Surprisingly little damage was done by the fire and the problem was swiftly identified. Enlarging the cooling inlets which fed air to the exhaust pipe region solved the problem. However, in following ground runs it was found that the overheating problems had not been completely overcome. In mid-June an error by ground crew left the engines running at high power for too long, in turn leading to the engines overheating to the point that they needed complete replacement. The prototype R2Y1 sat on the ground for another month while it awaited its new engines, at a time when USAAF B-29 raids on mainland Japan were intensifying. By mid-July the engines had still not arrived, a setback which was rendered entirely academic when a stray bomb from a B-29 raiding the nearby naval base scored a direct hit on the R2Y1.

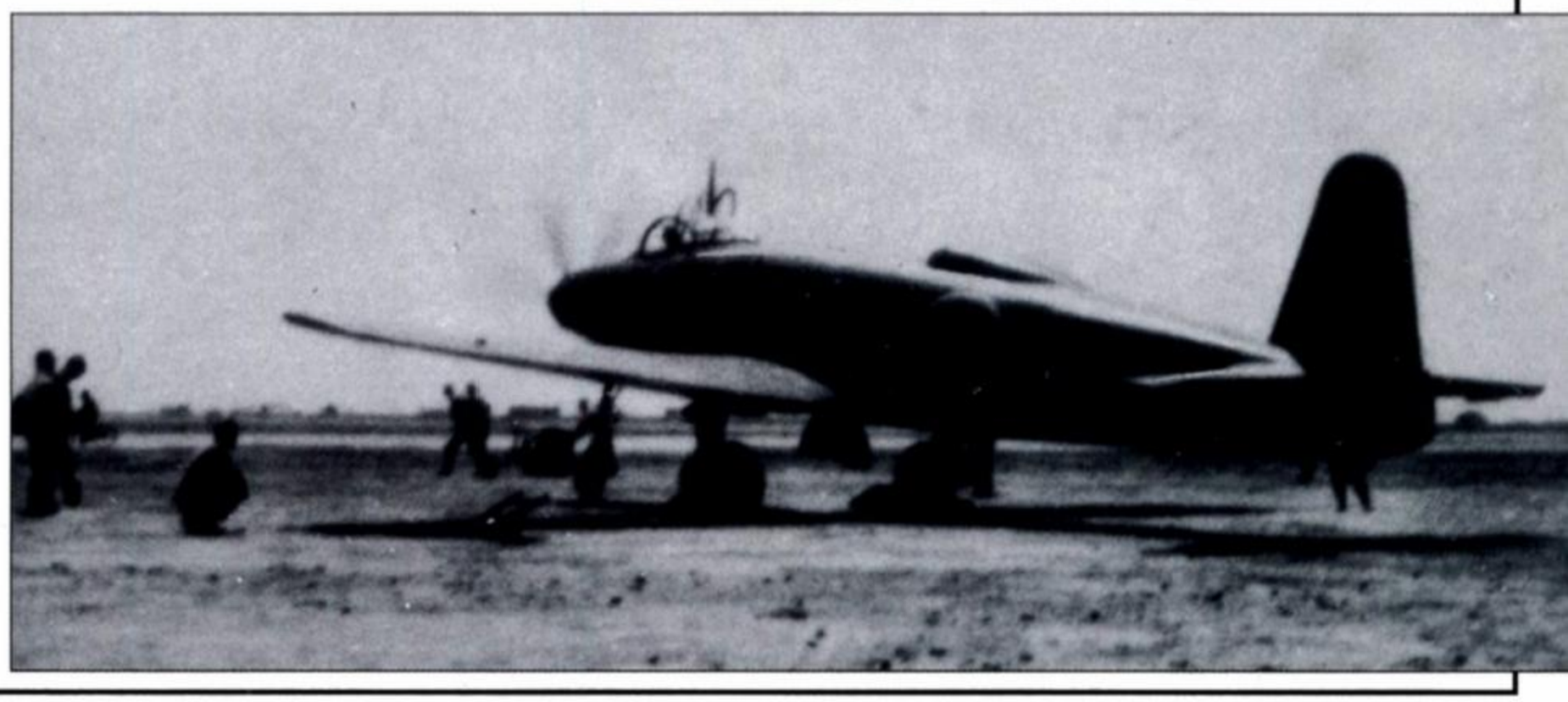
Above: Personnel crowd around the R2Y1 as it is prepared for its first flight. The Ha-70-10 engine drove a German-built VDM six-bladed propeller via a shaft which passed beneath the pilot's seat. The elimination of vibration in the shaft had been under study for some time.

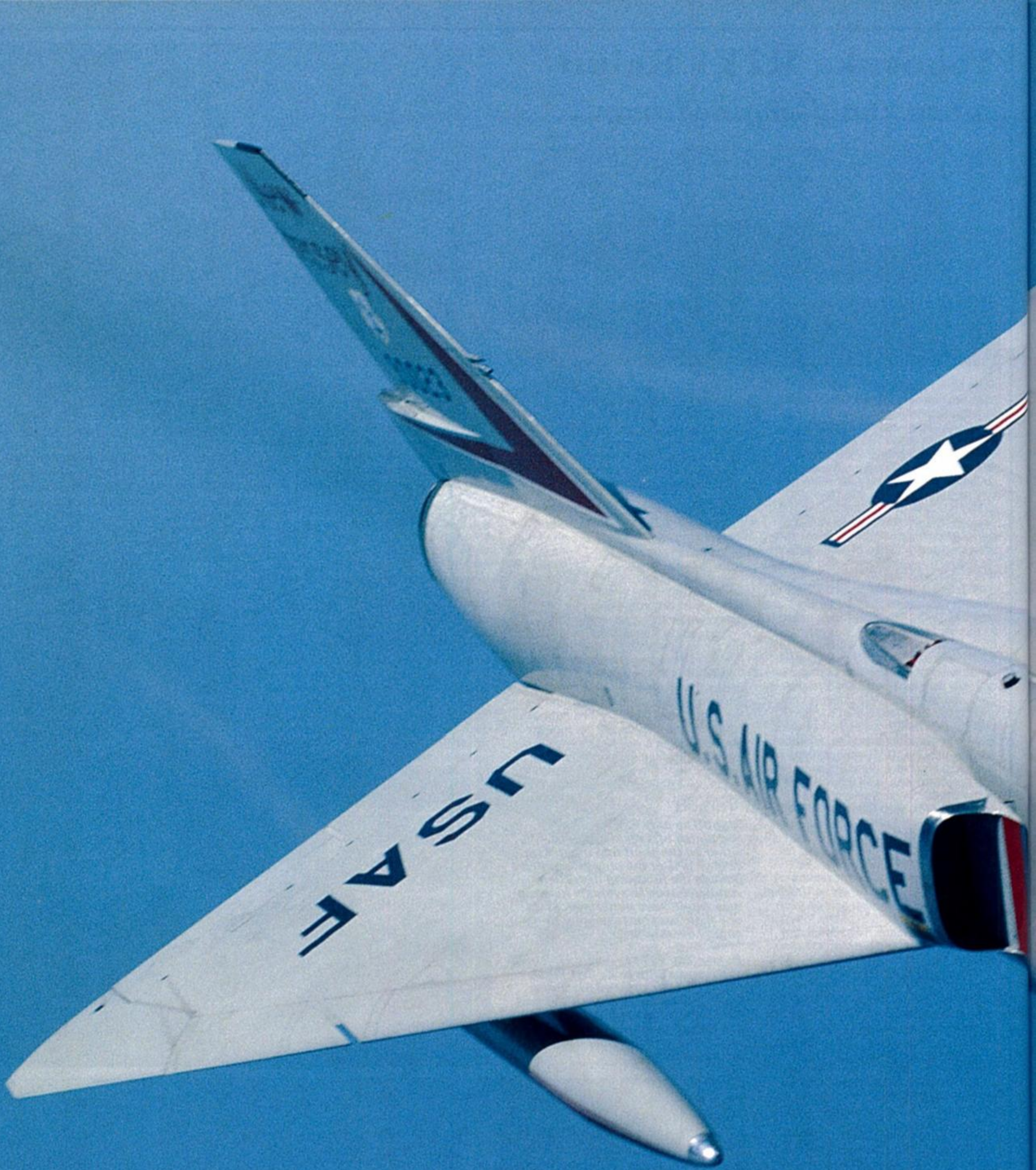
By this time a second R2Y1 was nearing completion, while work had already begun on the R2Y2. Using the same basic structure as the piston-engined aircraft, this aircraft would have featured two Mitsubishi Ne-330 turbojets slung in pods under the wings, each developing 12.95 kN (2,910 lb) of thrust. The space vacated by the R2Y1's piston engines was to have been used for fuel. Armament was to have consisted of heavy cannon and around 1000 kg (2,205 lb) of bombs.

Below: Lieutenant Commander Kitajima climbs aboard the R2Y1 for its first flight. The aircraft featured an unusual double-hinged canopy. Visible beneath the aircraft is the conventional radiator airscoop, the Japanese having decided against the German surface cooling system.

Right: The only R2Y1 to be completed lifts off at Kisarazu, either on the short hop it made on 22 May 1945 or the only proper flight it made the following day. There was no chance to evaluate how the type would have performed, as its one flight was curtailed due to engine overheating.

Below: The R2Y1 is seen running up at Kisarazu prior to its first flight. Having been cancelled in its own right, development of the R2Y1 was then reinstated to provide data for the follow-on jet-powered R2Y2 Keiun-Kai, which would have been an attack bomber.





More than simply a refined version of the F-102 Delta Dagger, Convair's F-106 encompassed state-of-the-art technology when introduced in 1959, including hands-off interception and a nuclear air-to-air missile. Conceived as the '1954 Ultimate Interceptor', the F-106 proved to be the last pure interceptor designed as such for the USAF and the last to be retired.

Convair F-106 Delta Dart

The Ultimate Interceptor

This view shows why the F-106 was initially called the F-102B. Despite their overlapping careers, the two Convair deltas were not often photographed together. This angle shows some, but not all, of the many differences between the two types, including the intake position and nose design. Less visible is the revised tailpipe area, and invisible here are the twin nosewheels of the F-106, its larger engine and the multitude of electronic improvements that set the two aircraft apart.

Although it rarely ventured overseas, the Convair F-106 Delta Dart made an indelible mark on military history: it stood guard on North America and it advanced the science of aeronautics. It was a bulwark of the Cold War and a glimpse of the future. Sleek and beautiful, the 'Six' had an impact on the US Air Force totally out of proportion to the 340 airframes that were manufactured in Convair's Plant 2 in San Diego, California and fitted out for final delivery a few miles away at Palmdale. The F-106 was a 'Cadillac of the skies' to some pilots, the embodiment of elegance to others. Always, it was a pleasing sight to the eye despite its grim mission: to detect, identify, intercept and destroy Russian bombers – and later, air-launched missiles – carrying atomic weapons to American cities.

If it had been nothing more than an effective interceptor, the F-106 still would warrant a niche in history – but it also capped an era of unprecedented scientific advances. Its 'case 14' delta wing, replaced in due course by the 'case 29' version, was the apex of an engineering development process that encompassed great and not-so-great warplanes – XP-92, XF-92A, F-102, F-102A, Sea Dart and B-58 Hustler. Its area-ruled 'wasp waist' reflected an important leap forward in designing aircraft for supersonic flight. From its radar to its afterburner, from its nuclear-tipped air-to-air missilery to its cockpit flight instruments, the F-106 set a standard of progress and innovation that was unmatched in the late 1950s and early 1960s.

More than an aircraft, the F-106 was really a system, linked via its complex Hughes MA-1 'Digitaire' electronic fire control system through a digital datalink into the nation-wide SAGE (semi-automatic ground environment) as an integral component in a high-tech – for its era – air defence network. A technological achievement when it first entered service at McGuire AFB, New Jersey in May 1959, the 'Six' aged quickly and became a prime candidate for in-service upgrades. Improvements to the F-106 included the addition of a gun (in a neat installation in the missile bay, causing a slight bulge), a revised canopy and supersonic wing tanks. Always more than the sum of its 'black boxes' and missiles, the F-106 remained an unrepentant Cold Warrior until retirement of the last aircraft by the New Jersey Air National Guard in 1988. Even thereafter, it soldiered on as a chase plane, test ship, and unmanned target drone.

Design and development

The F-106 saga began on 8 October 1948 when a board of USAF officers recommended a design competition for a new all-weather interceptor to be available in 1954. From their recommendations came the F-102 and F-106 interceptors. As a result of their work, in January 1950 the USAF invited 50 electronics firms to submit bids for a fire control system (FCS) for the '1954 Interceptor'. On 1 September 1950, the USAF invited 19 aircraft contractors – about six times the number of manufacturers of combat aircraft in the US industry today – to submit bids for the '1954 Interceptor' under Project MX-1554.

On 2 October 1950, the Pentagon awarded Hughes the contract for the '1954 Interceptor' FCS. It was known then as Project 1179 but became the MA-1 fire control system that was to become the operational heart of the F-106 Delta Dart.

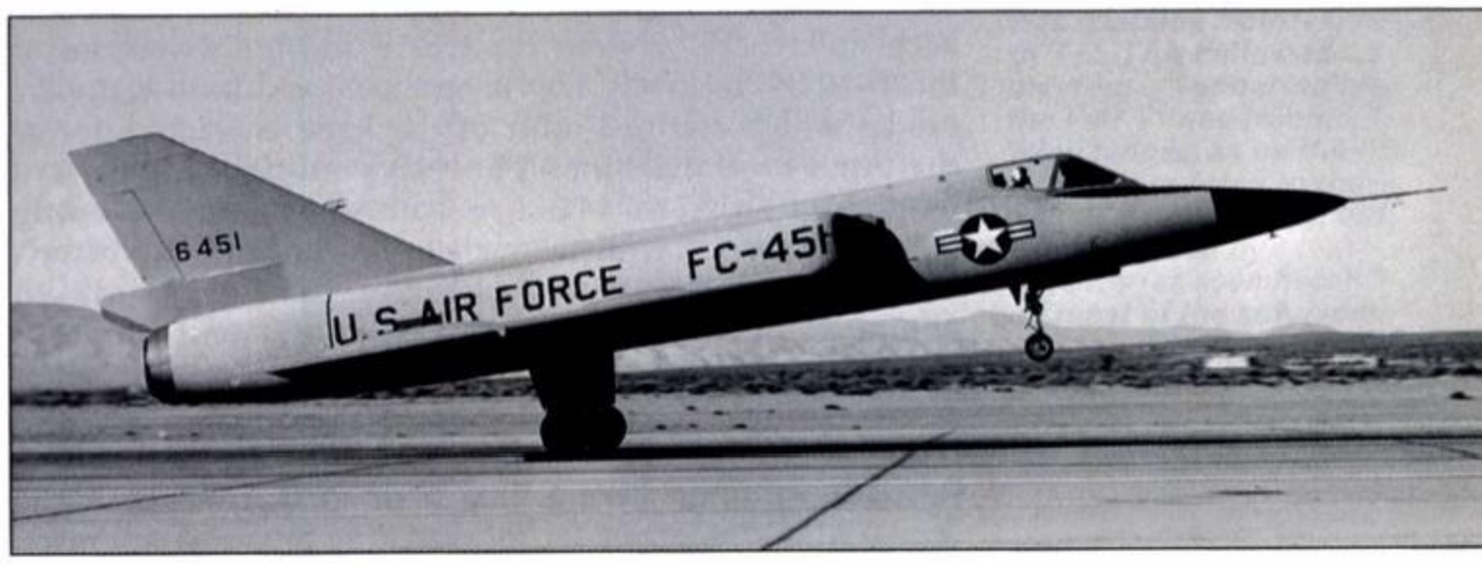
Convair had long ago designed a four-engined, delta-winged fighter called the XP-92 (which was never built) and a single-engined delta research ship called the XF-92A (flying at Muroc, California). The company became the USAF's choice on 11 September 1951 when it was awarded the contract for a prototype of the '1954 Interceptor'. The prototype was to exploit scientific work performed by Convair on delta-wing planforms. It eventually evolved into the F-102, which at the time was considered one of several 'interim' solutions to North American air defence.

It was a long route from the XF-92A test aircraft to the

The F-106 was probably the most colourful combat aircraft since the days of the 'Red Baron'. Air Defense Command's Fighter Interceptor Squadrons (FIS) competed, not only in formal competitions such as William Tell, but also to field the best-presented jets. This line-up of (left to right) 5th, 101st and 84th FIS Darts appeared at William Tell 1984.

operational F-106. Early progress with the MA-1 FCS was slow, and in November 1952 the USAF decided that the 'interim' F-102 would use the E-9 interim FCS instead of the MA-1. The long-sought MA-1 would be developed "patiently and gradually", as one document from the era described the unexpected delays, and would be put into the more advanced F-102B (company Model 8-21), the designation by which the F-106 was known at that time. Neither the 'interim' nor the 'eventual' version of the '1954 Interceptor' had been christened at the time and the popular names Delta Dagger (F-102) and Delta Dart (F-102B/F-106) came into use only in 1959.

In October 1953, the USAF leadership authorised the Air Research and Development Command (ARDC) to proceed with engineering work to make the forthcoming J75 engine compatible with the imminent F-102B (the future F-106). The J75 turbojet was chosen after plans to use the Bristol Olympus, which was to have been licence-built as the Wright J67, went awry due to technical problems. A Convair proposal to use the Rolls-Royce Conway as the powerplant for the F-102B appears to have attracted little interest. The J75 was based on the better-known J57, which at the time was the powerplant for several important warplanes, including the B-52 Stratofortress and the impending F-102A. Both were manufactured by Pratt & Whitney.



Above: The first YF-106A, 56-0451, left the ground at Edwards on its 20-minute maiden flight on 26 December 1956, narrowly meeting the stipulated deadline of the end of the year. At the time the aircraft was so secret that no photos or drawings had been released to the press. This photograph is believed to depict its first take-off.

Delta genesis

A bare beginning, and a premature one, was made with the first flight of a YF-102 (Convair Model 8-80) prototype (52-7994) on 24 October 1953 with Richard L. 'Dick' Johnson at the controls. Although the 'Y' suffix indicated a service-test mission, the YF-102 lacked virtually all of the features that would be found on the operational F-102 to follow and had none of the refinements of the future F-106. A report on the YF-102 proclaimed succinctly, "Performance was lacking." One wag ignored the clean shape of its delta wings and tail, focused on its portly fuselage, and called it a "flying beer barrel with wings." The canopy had metal braces that resembled prison bars. And, of course, it carried no armament or FCS. There were plenty of problems: on 2 November 1953, the YF-102 crashed wheels-up on its seventh flight, severely injuring Johnson. Development of the FCS radar appeared to be proceeding so slowly that some wondered if any of this work on a new interceptor would ever bear edible fruit.

The YF-102A (Model 8-10) prototype (53-1787) that made its maiden flight more than a year later on 20 December 1954 had a different shape, including an 'area-ruled' or 'Coke bottle' fuselage based on the research of NASA's Richard Whitcomb and intended to facilitate supersonic flight. This aircraft was outwardly similar to the F-102A Delta Dagger which followed and which turned out to be more than an 'interim' in expectation of the eventual F-106.

The J57-powered F-102A Delta Dagger, or 'Deuce', (Convair Model 8) and its 'fat' TF-102A side-by-side cohort (the 'Tub') eventually played an enormous role in the defence of North America and NATO, and fought briefly in Vietnam, where one was shot down by a MiG-21. The F-102 equipped Air National Guard squadrons, served in Greece and Turkey, and ended its days as an unpiloted drone target. The operational F-102s used a fire control system called the MG-10 which included a radar element designated MG-3 (after the earlier E-9 FCS proved inadequate). The MG-10 system was the FCS of choice for proposed (but never built) export versions of the MA-1-equipped F-106. Convair manufactured 1,000 F-102s between 1953 and 1961, and this much-loved warplane justifies its own book. For our purposes, however, we will skip quickly past the long and valiant career of the

Above left: The second aircraft flew exactly two months after the first, having also been trucked from San Diego to Edwards. The first three test aircraft wore 'FC' 'buzz numbers' as on the F-102A, reflecting the type's origins as the F-102B.

Top: 56-0461 was the ninth flying F-106 built (aircraft no. 3 was used for static tests) and is seen here over Edwards during the Category II test programme. It was one of the development aircraft later refurbished and issued to Air Defense Command. Finally leaving service with the 5th FIS in 1995, it is currently stored at AMARC.

The first F-106 is seen later in its career when adorned with high-visibility Dayglo trim. After a career of fewer than four years, it was retired and became part of the USAF Museum collection. Today it is displayed at Selfridge AFB, Michigan with a spurious serial number.

F-102 in order to relate the tale of the true '1954 Interceptor', alias the 'ultimate F-102B' (Model 8-24, formerly 8-21), which on 17 June 1956 was redesignated F-106A. This was also dubbed Weapon System WS-201B.

Navy Dart

While the earlier designation was still in effect (on 20 June 1955), Convair produced a report summarising its efforts to design and sell a US Navy carrier-based, high-altitude version of the F-102B (the future F-106). The company had earlier proposed a similar version of the F-102A, and the new proposal might have given the Navy a new aircraft contemporary with the McDonnell F4H-1 Phantom and Vought F8U-3 Crusader III. Convair tried to keep differences between the USAF and USN versions of the F-102B 'relatively few in number' and built a display model which retained most of the basic characteristics of the Air Force machine. The Navy model would have employed an Aero 11B fire control system including AN/APQ-50 radar, then much in favour with the Navy's Bureau of Aeronautics, together with a BuOrd Mk 16 combination sight and radar scope. Armament was four XAAM-N-2A (the future AIM-7A) Sparrow 1A missiles, which required a slight extension of the internal weapons bay. Alternate ordnance loads included two Ding Dong missiles (the future MB-1 Genie) or six XAAM-N-7 (the future AIM-9) Sidewinder missiles. The proposal was made with allowance for either the J67 (still then under consideration) or J75 engine.

The Navy's F-102B (the future F-106) would have had a strengthened wing to increase maximum *g*-load factor from 7.0 to 7.5. The empennage of the Navy fighter incorporated minor changes to accommodate Navy electronics antennas and to permit the tip of the fin to fold for shipboard stowage. The strengthened landing gear would have included dual independently-rotating nosewheels and a somewhat stronger main undercarriage. The tailhook envisioned for the seagoing F-102B was quite small, tucked at the extreme rear of the engine exhaust area. A Navy expert from the period remembers that, "Convair and their people were very eager but we had our eyes set on other fighters, so we said thanks, but no thanks." Had such an aircraft been built, using the naval aircraft designation system then in effect, it almost certainly would have become the Convair F3Y-1 Delta Dart. The term Sea Dart, of course, was already taken by the same builder's F2Y-1 flying-boat fighter which was then the subject of a vigorous research and development programme.

Production contract

Air Force officers and industry came together with a November 1955 contract for the first 17 aircraft (56-451/467), still using the original military designation F-102B. The contract was finalised and the F-102B construction order placed on 18 April 1956. Weeks later, the designation changed from F-102B to F-106A. On 3 August 1956, the USAF authorised a two-seat TF-106A (Convair Model 8-27) variant. The Pentagon changed the designation to F-106B by the end of that month.

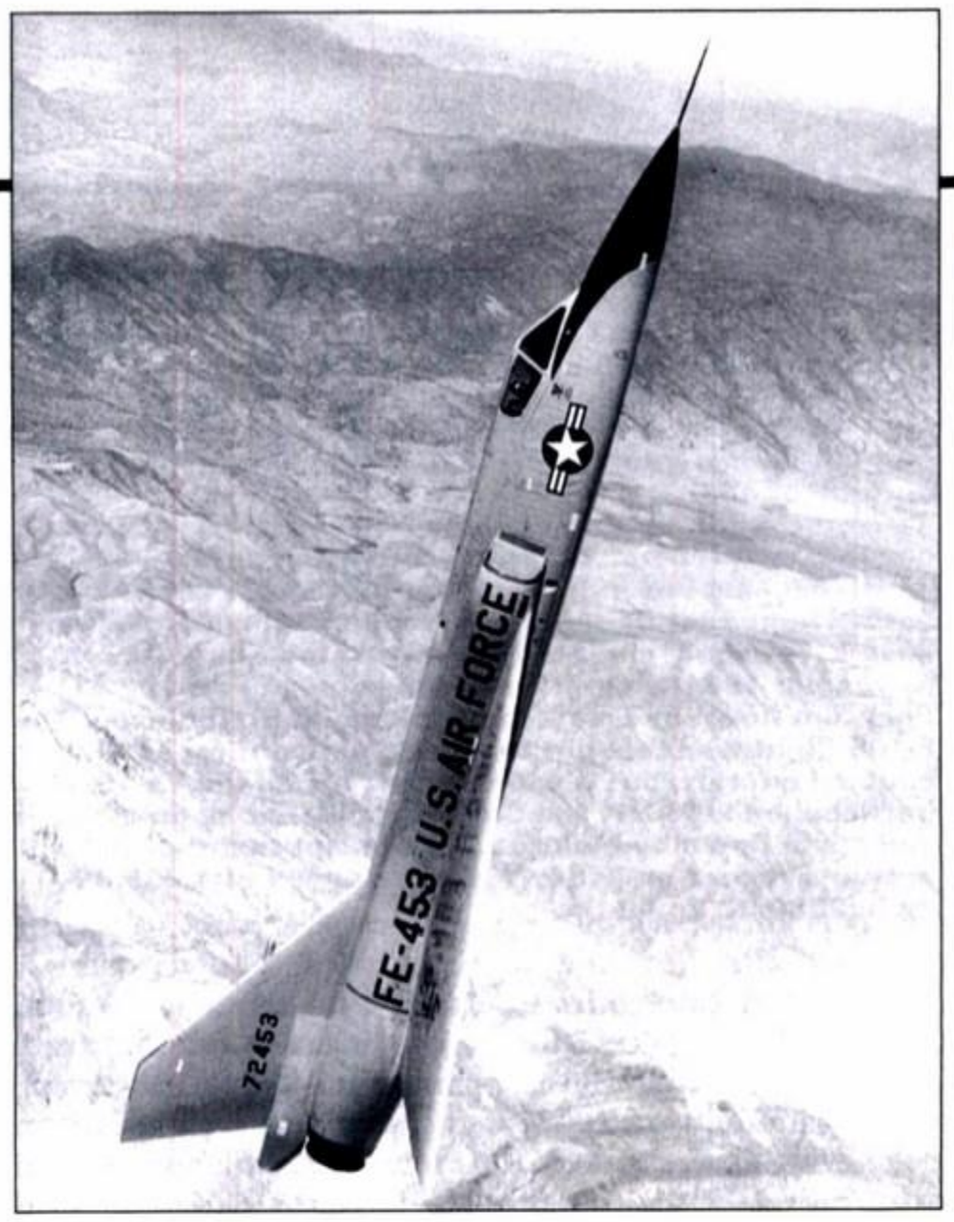
Progress was slower than had been hoped. To develop the fire control system, initially called the MX-1179 FCS but soon redesignated the MA-1 FCS, Hughes Aircraft had acquired on bailment an NT-29B aircraft (Convair 340) in 1953 or 1954. At various times, two NT-29B aircraft (51-5164 and 51-7912) flew as airborne radar testbeds and it is unclear today which of them might have been in service as the Hughes testbed when, much later than originally hoped, the company began flight testing of the MA-1, in December 1956.

Test programme

The test programme for the F-106 was extensive and lengthy. The Edwards phase alone involved 12 aircraft and lasted until mid-1959. Although there were no problems of the magnitude that plagued the original F-102, supersonic acceleration in particular proved disappointing, and there were engine, fire control system and cockpit layout problems as well. The expensive modifications required nearly killed the whole programme when the USAF faced a funding crisis in 1957. Many changes were still required before the 'Six' could enter service.

Above: The eighth F-106 lifts off on a test flight. This aircraft tested the intake configuration fitted to production aircraft. The new, larger inlet with thinner duct lips improved the aircraft's range, ceiling and acceleration.

Left: A civilian, probably a Convair rep, briefs a test pilot before a hop from Edwards in the third test ship, which was delivered in August 1957, the scene being recorded by a company photographer. As the development programme progressed in parallel with production, aircraft diverged further from a common standard, causing the USAF many headaches as the F-106 entered service.



The first F-106A (Convair Model 8-24) aircraft (56-0451), sometimes referred to as a YF-106A with the 'Y' prefix indicating a service-test role, was completed in late 1956. One mystery revolving around the F-106 story is the question of why Convair apparently never held a roll-out ceremony or other celebration to mark the appearance of this new fighter for the Air Force. Possibly, officials believed that a ceremony would call attention to delays in the programme. Furthermore, photos of the F-106A were not yet cleared for release to the public. For whatever reason, the first aircraft did its first travelling on a flatbed truck. Meanwhile, the Air Force designated the F-106A as Weapon System 201B, a term intended to emphasise an integrated, well-orchestrated effort to develop aircraft, radar, electronics and armament as a co-ordinated 'package' – when, in fact, the entire developmental effort was proceeding in fits and starts.

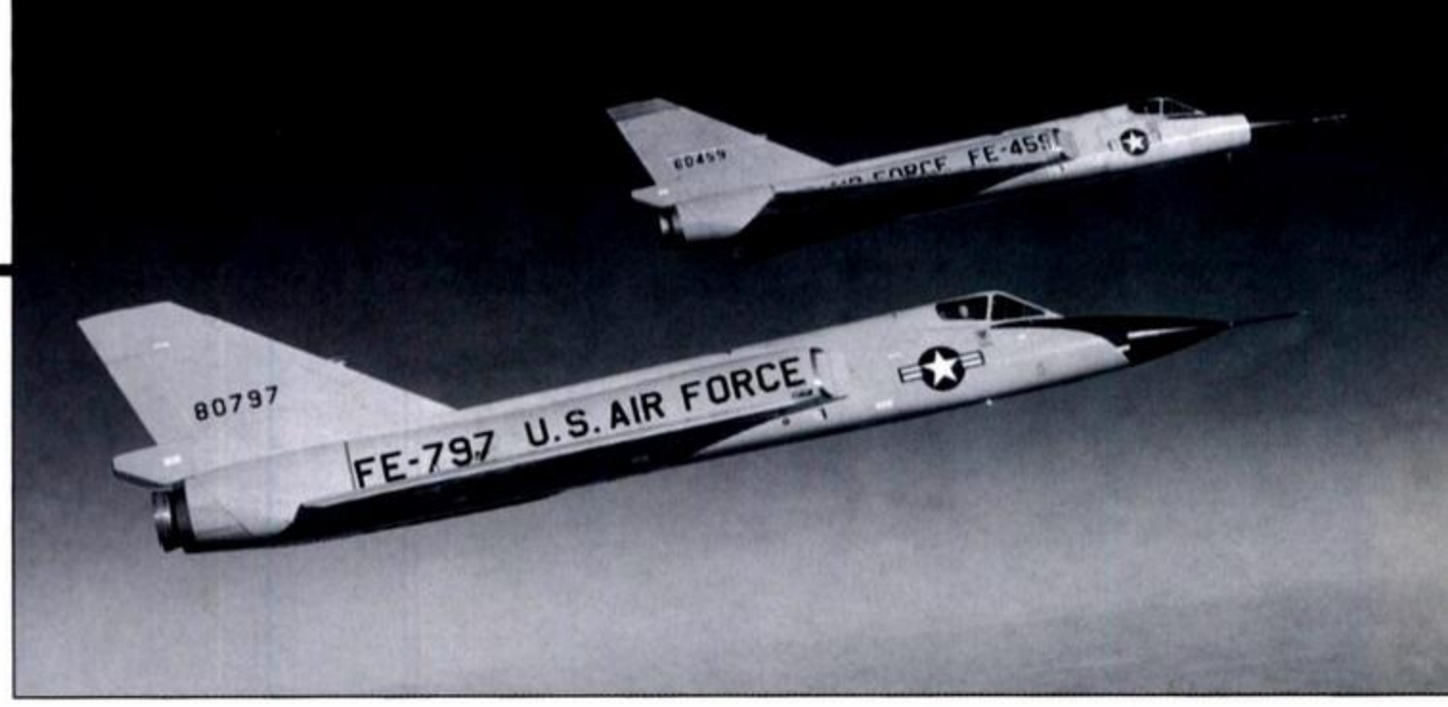
Flight test

Taxi tests began at Edwards on 22 December 1956. On 27 December 1956, the *San Diego Tribune* reported the initial flight of an aircraft that had not yet been seen by press or public, and of which no drawings or artists' conceptions had yet been released. The pilot was Richard L. Johnson, the ex-Air Force test pilot (and veteran of combat in the Mediterranean) who had joined Convair's San Diego operation in 1953 and had previously made the premier flight of the F-102. The newspaper gave no reason why 26 December 1956 – as the day after Christmas, it was normally a quiet day – was chosen for Johnson to take off in his "hot new fighter-type jet" on the 20-minute maiden flight at 2:50 p.m. In fact, the manufacturer was struggling desperately to fulfil a contractual obligation to fly the aircraft by year's end.

Marty J. Isham, an Air Force civilian who is the leading expert on the F-106, remembers how time pressures affected the flight test effort. "As everyone in the programme knew, the '1954 Interceptor' was way behind the power curve. Weapon System 201B had to be operational and provide an all-weather air defence system for the period 1959 through 1962. This requirement was established by GOR No. 4 (ADI 51-1) dated 27 December 1951, and in accordance with ARDC System Requirement No. 82 dated 1 November 1955. To satisfy contract requirements, the now F-106A HAD to fly in 1956! Time had run out!"

In fact, although news reports missed it, pilot Johnson's maiden flight in the 'Six' was aborted due to air turbine motor frequency fluctuation. Worse, the speed brakes opened and would not close. Glitches like this were not uncommon in an early test flight, but it was a contrast to an early success in another 'Century Series' programme: more than two years earlier, on 29 September 1954, McDonnell test pilot Robert C. Little had made the maiden flight of the F-101A Voodoo at Edwards in a flawless first outing that made the Voodoo the first aircraft to go supersonic on its debut. The contrast between the flawless start by the ugly, ungainly F-101A and a frustrating first flight by the 'Six' may not have attracted comment at the time, but in retrospect it puts in sharp relief the developmental problems that were dogging Convair and Hughes.

Nor would a Soviet intelligence analyst have gained much from the *Tribune*'s report on the first flight: "Electronic aiming devices in the F-106A and its armament are said to be improved over those in the F-102A," the newspaper ventured, "[but] no further information is available." In fact, the first two examples of the 'Model 8 Airplane', known to the builder as Prototypes 8-20-1 and 8-20-2 (F-106As 56-451/452), were aerodynamic test vehicles. (The Model 8-24 designation applied to the generic design.) The two prototypes had no provision for the Hughes MA-1 AWCIS (Aircraft & Weapons Control Interceptor System) and "no provision for installation or retrofit of any armament configuration except that the MB-1 armament bay doors [are] to be installed and operative." In fact, they carried ballast in the nose to preserve the design centre-of-gravity. MA-1 was, of course, the radar fire control system; MB-1 was the Douglas Genie nuclear-tipped missile.



Above: Still showing evidence of intake modification, 56-0459 flies with a much later example (line number 160, delivered in November 1959). '459 is today displayed at McChord AFB, whereas '797 was shot down as a QF-106 drone out of Tyndall AFB in 1990.

Far left: After the first three aircraft, the 'buzz number' for the F-106 was changed from 'FC' to 'FE'. This code had previously been used on the F-47 Thunderbolt. Wing fences, as on the F-102, were fitted to the first 17 F-106As to fly, but were replaced by notches (as seen here) on most of the survivors.

Description

At this point, a description of the F-106A is in order. A 1957 US Air Force document sets forth basic facts about the F-106A Delta Dart, which lives today in the minds of many who see it as the most beautiful warplane ever built: "The F-106A was a single-place, delta-winged, supersonic airplane built by Convair to serve as an all-weather interceptor. Features of the airplane included an area-rule

56-0453 was the third F-106 to fly and was delivered from the factory in August 1957. After a long career, it was converted to QF-106 configuration as AD111 and was lost in a crash at Holloman on . 27 January 1995.

Speed record

On 15 December 1959, Major Joe Rogers broke the world absolute speed record in an F-106A with a flight measured at 1,525.93 mph (2455.68 km/h), eclipsing the 1491.3-mph (2399.95 km/h) mark set by Colonel G. Molosov of the USSR on 7 October of that year in the Mikoyan Ye-152-1. The flight was conducted on a straight-line course 11 miles (18 km) in length, at an altitude of 40,000 ft (12192 m). The flight was noteworthy for another reason – the aircraft used was not the one prepared for the record attempt (56-0459), which became unserviceable on the day, but another Air Force Flight Test Center aircraft (56-0467) which did not have a 'tweaked' engine. The record stood until 22 November 1961 when it was broken by an F4H-1F Phantom flown by Lieutenant Colonel R. B. Robinson. The F-106 flight was thought to remain a record for single-engined aircraft, but it appears that it was the Ye-152-1 (mislabelled E-166 by the Soviets) powered by one R-15, and again flown by Molosov, that recaptured the absolute record on 7 July 1962 at a speed of 1,665.89 mph (2680.92 km/h).

Top: Major Joe Rogers prepares to board 56-0459, the planned mount for the record attempt. In the event, this aircraft became unserviceable, and Rogers flew 56-0467 (above).

fuselage and a pressurised cockpit equipped with an ejection seat. The flight control system utilised elevons to give both aileron and elevator action." Here, the simplicity of the delta wing was a virtue. As company test pilot Dick Johnson put it, "There are no trailing- or leading-edge flaps, slots, or boundary layer bleeds or controls to lower, extend, turn on, or check [and] no trim changes to anticipate or correct for."

Wing design

The wing of the F-106A was developed from the planform employed by the F-102A. The original version, called the 'case 14' wing (or 'case XIV'), found on aircraft with Fiscal Year 1956 serial numbers, had outer-wing boundary layer fences as on the F-102A. The fences were replaced on the production-standard 'case 29' (or 'case XXIX') wing with leading-edge slots. The F-106 had a 'wet' wing with no fuel bladders, a characteristic later to be quoted as perfectly acceptable in the continental United States but a handicap if used in Vietnam (as was later considered). Fuel transfer was accomplished by low air pressure, bleeding off low-psi air pressure from engine into tanks. "A bullet hole in your wing and you'd lose air pressure," said pilot Lieutenant General Ranald Adams. "I don't know how many holes it would take, but ..." The delta-winged interceptor could outperform the F-4 Phantom above 20,000 ft (6096 m) but was not deemed effective in air combat manoeuvre down low because of its elevon load limit.

The simplicity of the delta wing was an enormous part of its appeal. A conventional aircraft used movable ailerons, elevators and stabilisers for longitudinal control, and flaps, perhaps slots also, for lift augmentation – as contrasted with nothing more than elevons and a large wing for high lift on delta-winged aircraft. Having fewer control surfaces and actuating systems was a gift to maintainers. Convair noted that, "Pilots have more freedom with fewer controls to actuate [and] find the delta wing safer. The lack of movable surfaces and their operating mechanisms lends ruggedness to a delta-winged aircraft. The delta shape is not only ideal from an aerodynamic standpoint, but also approaches the ultimate shape for structural strength and stiffness. This precludes flutter and other forms of structural instability."

Automatic flight control

The F-106's AFCS (automatic flight control system) operated its elevons (aileron-elevator surfaces on the trailing edge of the delta wing) in response to commands received from the digital computer. Information received by the AFCS originated in the flight-sensing instruments, ground stations feeding intelligence to the MA-1, the Delta Dart's own radar system, and the computer's own memory drum. AFCS also functioned during the return portion of the mission.

Returning to the description from the 1957 document: "The tricycle landing gear was equipped with an electrically-controlled, hydraulically-powered nosewheel steering unit. An automatic fuel transfer system controlled the centre-of-gravity location during supersonic high-altitude flight. Engine variable inlet ramps [very much a new feature in 1957!] were provided to obtain optimum airplane performance at supersonic speeds with full engine power, and to maintain engine inlet airflow stability over a wide range of speed and altitude."

The Pratt & Whitney YJ75-P-1 twin-spool, axial-flow turbojet engine (company model JT4A) with afterburner (the initial model of the same engine that powered the F-105 Thunderchief) was rated in an AFFTC report at 15,000 lb (66.71 kN) static thrust at sea level at military power and 23,500 lb (47.41 kN) static thrust at sea level at maximum power. In time, the 'Six' was to progress to -9 and -17 versions of the engine.

F-102 and F-106 production ran in parallel for some time at San Diego. Here, an F-102-80-CO, the 183rd from last 'Deuce' to be built, sits unpainted next to the seventh, similarly unclothed, F-106A.

The F-106 became the first fighter in the USAF to be fitted with a tailhook, although for land use only. It was designed by Bruce Sheaffer of the All American Engineering Company, which also provided the 'water squeezer' arrester cable system. The first F-106, by now belonging to AFFTC, undertook many tests, proving that the 'Sheaffer hook' met the air force's requirement of arrestment from 110 kt (204 km/h).

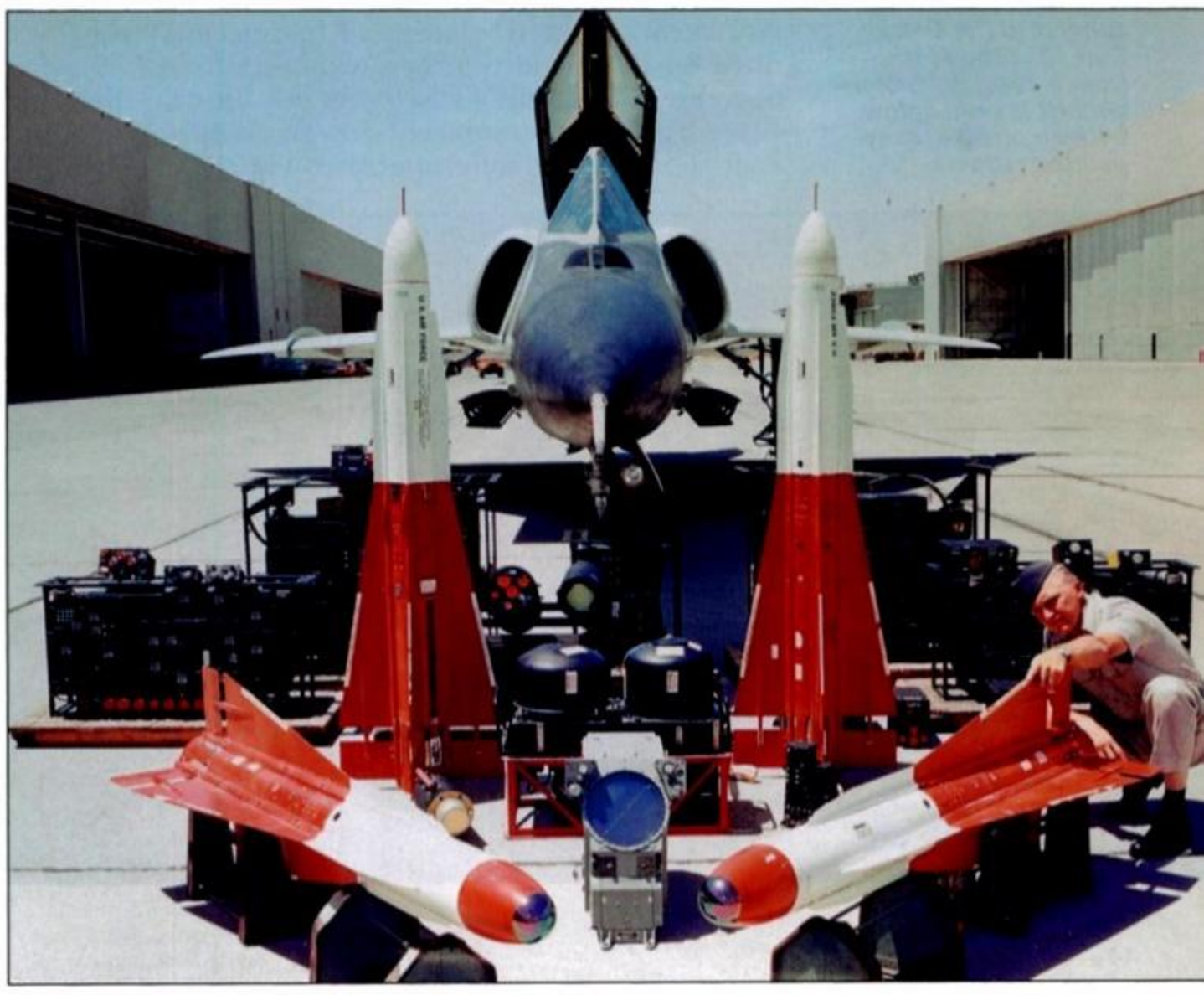
In contrast to the F-102A, the F-106A fuselage was extensively modified with a more streamlined shape, having the variable ramp air intakes moved well aft of the nose, closer to the engine. The fin and rudder shape was changed markedly and a new landing gear installed with steerable, twin nosewheels. There were also numerous small measures designed to make the F-106A fast as well as formidable: the upper and lower rotating navigation beacon lights (immediately aft of the canopy in the dorsal position, and immediately behind the nosewheel on the belly of the aircraft) were designed on early F-106s so that they retracted when the aircraft went supersonic. In later years, this feature was disabled and the beacons no longer moved.

Cockpit design debate

The pilot of the F-106A sat far forward, well ahead of the engine intakes, but significantly back from the windshield. As will be noted below, early F-106As had both centre- and sidestick control columns, but the USAF settled eventually on a unique, two-handed grip for traditional control of the aircraft (right hand) and operation of the radar (left). This was for practical purposes the same as the 'yoke' used on most non-fighter aircraft. A button between the two grips activated the left grip, giving the pilot control of the radar antenna; another button atop the left grip enabled the pilot to put a pipper on the target by following directions on the radar scope. Pilots were supposed to be encouraged to have radar and autopilot engaged simultaneously as much as possible, part of the lore of this being an 'automatic' aircraft ("a man-carrying guided missile," according to one publication), but most stuck to the old ways. Besides, if the radar had what was called a 'hot dot discrepancy' with the autopilot engaged (the image representing the F-106 at the centre of the radar scope), the aircraft would bounce the pilot about rather harshly. The pilot selected his missiles to be fired using a switch on the left console; the trigger to launch missiles was on the right-hand grip.

Design of the cockpit of the F-106A was influenced by experience with the F-102 Delta Dagger and initially featured a typical analog instrument display. (A USAF study in the mid-1950s showed that pilots were using 26 different instrument and flight-control arrangements in jet aircraft, leading to a call for standardisation that had not yet been made when the F-106 was designed.) The cockpit display had not been approved during the initial mock-up inspection of the aircraft, and the USAF demanded that further work be done. The MA-1 AWCIS in mock-up form made use of vertical-tape instruments (not initially adopted by production F-106s, though they came later), a side control stick (sidestick controller), a 10-in (25-cm) horizontal map display and a radar screen (not the Hughes MA-1 fire control display). Apart from the map display, these items marked a radical departure from customary Air Force cockpit instrumentation and resulted in a decision to develop two cockpit configurations simultaneously in the first 12 developmental aircraft. Six had the sidestick con-

In this publicity shot from the 1950s, Hughes Aircraft Company test pilot James J. O'Reilly holds up a 36-in (91 cm) aluminium disc target pierced by a Hughes GAR-4A (AIM-4G) Falcon. The disc was suspended from a tower at Holloman AFB and heated to simulate a jet exhaust. O'Reilly's F-106A was "more than a mile away" when the missile was fired.



The MA-1 weapons system included the missiles, radar, computers and the F-106 airframe. All but the aircraft itself were manufactured by Hughes. This tableau shows AIM-4F (rear) and AIM-4G missiles, the radar scope (but not the scanner) and the many 'black boxes' in the system.

A trio of 'Geiger Tigers' F-106s poses for an early publicity shot. ADC felt that the Delta Dart as delivered was far short of being operationally ready, and niggling problems with generators, fuel flow, starters and canopies led to a temporary grounding in December 1959.

Into service

The first two units to receive the 'Six' were the 539th FIS at McGuire AFB, New Jersey and the 498th FIS at Geiger AFB, Washington on 30 May and 1 June 1959, respectively. Despite technically being the second Delta Dart operator, the 'Geiger Tigers' were undoubtedly first to stand and launch an alert – on 21 July 1959 – and declared initial operational capability (IOC) in October. This was five years later than originally planned for the '1954 Ultimate Interceptor'.

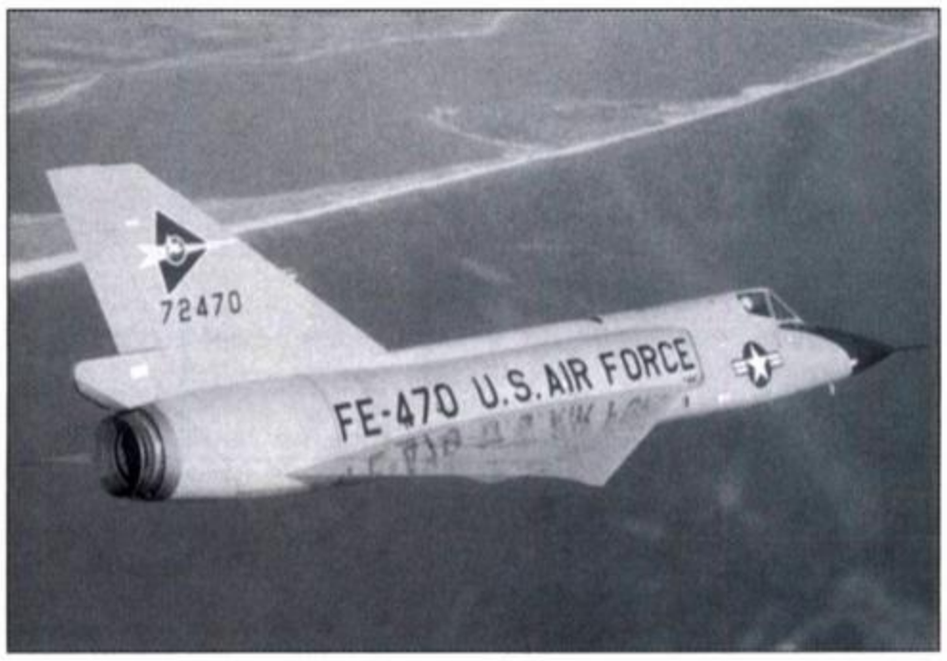
troller while six had a standard centre control stick with radar screen and some non-standard instruments, becoming known in flight test as the 'Sacred Six'. They had provisions for the sidestick controller to be installed.

The other six developmental aircraft had a Hughes MA-1 cockpit display, non-standard vertical tape instruments, radar screen display, horizontal map display and sidestick controller with provisions for a centre stick.

Some early F-106s with FY 1956 serial numbers had an additional fuel cell in the fin. It quickly became apparent that if this tank did not feed properly, the aircraft was almost impossible to land because of C of G problems. After the early flight test phase, this fuel tank was retained on the early aircraft but was never used in actual operations.

As a feature on newly-built aircraft, the vertical-tape instrument set, or IID (Integrated Instrument Display), was fitted on the production line with aircraft 58-0759. The first three squadrons of F-106As put into the field had analog, or 'round', instrument dials and, although some aircraft subsequently were upgraded with IID as indicated below, many served their entire lives without ever getting the vertical tapes. In the case of the two-seat F-106B, the IID mod began at the factory apparently with aircraft 57-2525.

The 'brain' of F-106As was the MA-1 AWCIS 'Digitaire', the Delta Dart's airborne digital computer and fire control system created in what was little less than an engineering miracle by a young and vigorous Hughes company. A key sub-system was the TSD (Tactical Situation Display) that projected a map display onto a cockpit screen, permitting the pilot to follow the course of the mission pictorially. An automatic feature changed the



Above: This is a 539th FIS F-106A, one of the participants in William Tell 1961, the first in which the F-106 took part.

Below: While the 498th was working towards IOC, the 539th was carrying out the Category III test programme, involving proving of the weapons system at Tyndall AFB. The missile-firing phase ended in May 1960. The F-106B was declared operational in July of that year.

The 27th FIS at Loring AFB, Maine was the third squadron to convert to the Delta Dart (like the 498th, from F-102s). One of its aircraft is seen below with an unusual grey-painted radome.

maps along with the aircraft's location. Small symbols on the screen represented the aircraft, the position and movement, and the heading the F-106 needed to fly to reach the target.

The USAF viewed as extremely serious the business of the F-106A/MA-1 'weapon system' – the term was in vogue to emphasise that an airframe was meaningless – which was to intercept and destroy Soviet bombers, both subsonic and supersonic, operating from sea level to over 70,000 ft (21336 m). From the start, the armament of the F-106 was to include one Douglas MB-1 Genie, an unguided rocket projectile with a nuclear warhead. A number of sources which list the aircraft as being able to carry two Genies are incorrect. The single rocket was expected to assure a kill of an approaching bomber or bomber formation. (Initially known as the Ding Dong, the MB-1 Genie was redesignated AIR-2A on 1 October 1962. There was not an improved version called the AIR-2B, despite published references to the contrary.)

Super Falcon

In addition to the Genie, the armament of the F-106 included advanced versions of what had been the first US air-to-air missile, the Hughes Falcon. Although it was besmirched in later years by pilots who found it inadequate for fighter-versus-fighter combat in Vietnam, the Falcon was in every respect a scientific advance and an impressive achievement. It was originally known as the MX-904 Dragonfly but carried the USAF designation XF-98 until 20 August 1955. As developed for the F-106, these missiles totalled three variants: the GAR-3 and GAR-3A Super Falcon SARH (semi-active radar homing) missiles and the GAR-4A Super Falcon IR-homing missile. The designations of the three were changed, respectively, to AIM-4E, AIM-4F and AIM-4G on 1 October 1962. The F-106 was configured to fire Super Falcons in pairs and routinely fired one radar-guided and one IR-guided missile simultaneously. USAF pilots often grumbled, especially in later years, that the Super Falcon needed more range.

The GAR-3 (AIM-4E) was the first of the Super Falcons designed specifically for the F-106A. Hughes produced 300 before shifting to the GAR-3A (AIM-4F). The AIM-4E incorporated SARH with a contact-fused small HE (high-explosive) warhead deemed to be useful against a bomber only in attacks aft of beam. For example, attacks against a non-manoeuvring Myasischchev Mya-4 'Bison' bomber at 60,000 ft (18288 m) when made 30° aft of beam produced a Pk (probability of kill) of 8.4. From 135°, forward of beam, Pk dropped to 0.04.

The GAR-3A (AIM-4F), introduced in 1960, had improved radar guidance and hence greater accuracy, as well as greater reliability. It remained the standard radar missile for the F-106 throughout the interceptor's service career. The solid-fuel, bi-level thrust rocket engine of the 'F model' Super Falcon increased initial launch thrust. The missile proved successful under great extremes of temperature and in various manoeuvre regimes.

The GAR-4A (AIM-4G) Super Falcon was developed as an IR-seeking counterpart to the radar missiles. Pilots from the era say that they could get an infra-red track on some jet-powered vehicles (such as the widely-used Firebee drone) from the front, even though the concept of an 'all aspect' missile lay far in the future and the GAR-4A was most effective in an 'ass end' attack. The pilot's radar display (which also displayed what was seen by the IR missile's seeker head, and in later years by an IR sensor installed in the nose) would show spikes to indicate heat sources. All Super Falcons were contact-fused, with the fuses located on the leading edge of all four fins, so that a direct hit on the target was needed to effect a kill. In fact, while a glancing blow could be lethal, if the missile struck a target straight-on it would have to penetrate in order to detonate.

Above: 56-0462, the 11th F-106, appeared alongside its big brother, the B-58 Hustler, at a display at Andrews AFB in March 1960. Convair's Delta Dagger, Delta Dart and Hustler remain the only pure delta aircraft to have served with the USAF, apart from the SR-71.

Training missiles

In addition to 'real' Super Falcons, the F-106 carried inert AIM-4E/F/G missile rounds which could be fired for practice or in tests but which did not have a warhead. More frequently, the F-106 carried the Super Falcon WSEM (Weapons System Evaluator Missile), a dummy with a real seeker head that could track the target and simulate a real missile, but could not be launched from the aircraft. Because this was the routine way to practise missile firing – something which was rarely done, in any case – even an experienced pilot could go a number of years without firing a real Super Falcon. WSEMs were deemed essential to realistic training and practice because the pilot experienced most phases of an actual missile shoot, including opening the doors and extending the missile: they simulated everything except the real-world performance of the rocket motor.

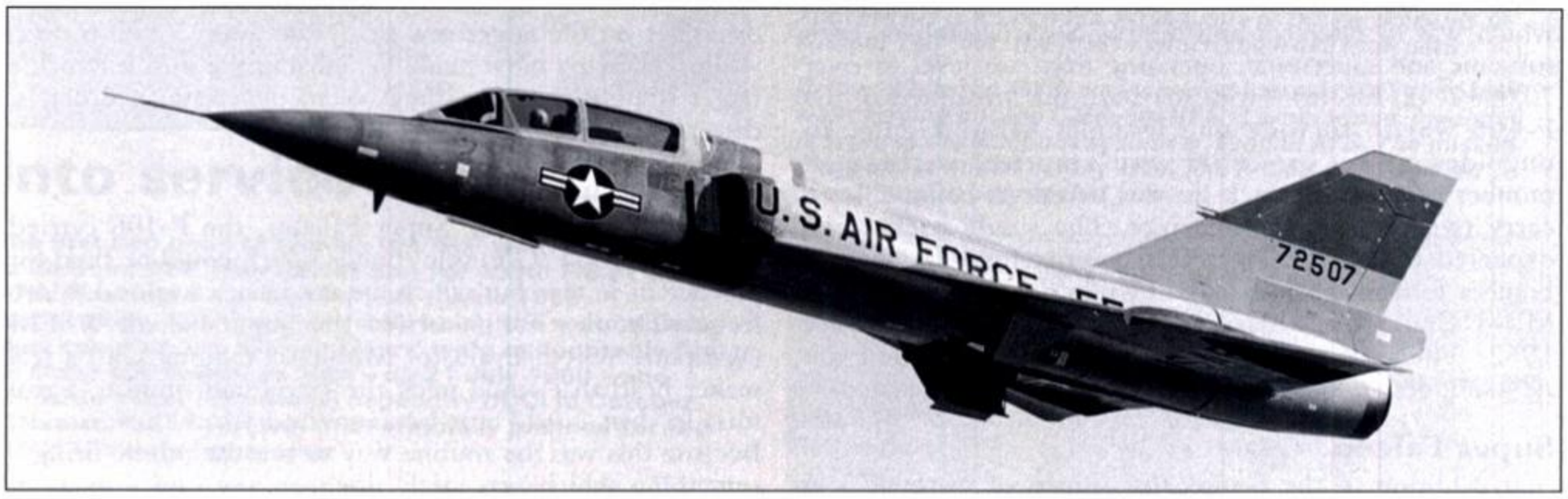
Above left: The 5th F-106A later served with the Flight Dynamics Lab of the Aeronautical Systems Division at Wright-Patterson AFB, where it was seen in September 1966.

The Genie, which also armed the Northrop F-89 Scorpion, reflected its era. Being an unguided, gyro-stabilised rocket, the Genie was a 'projectile', not a 'missile'

Convair put up this unique formation of F-106A, B-58A and 880 in 1959 to illustrate the fact that it made the world's fastest fighter, bomber and airliner. Of the three types, the F-106 was to be produced in the greatest numbers (340), compared to 116 Hustlers and 65 880s.

Two-seat 'Six'

The go-ahead for construction of a dual-place F-106 was given in August 1956, before the single-seater's first flight. Unlike the TF-102A with its side-by-side seating and inferior performance to the single-seater, the F-106B was designed to be as close to the F-106A in configuration as possible. The aircraft was not designated TF-106A, to reflect that it was more than a trainer and carried all the mission equipment of the basic interceptor. The first aircraft, 57-2507, did not fly until 9 April 1958 and was delivered four days later. The B suffered from the same development troubles as the A, and although nine aircraft were delivered by the end of 1958, none of them was assigned to operational units until the following year, the two-seater being declared operational in July 1960. The flyaway cost of an F-106B was estimated at $4.9 million, $200,000 more than an F-106A . The last of 63 F-106Bs was delivered in December 1960.



Above: The first F-106B was never assigned to ADC, being used for trials, principally ejection seat tests. Passing to NASA as '616' (later '816'), it was used for a variety of atmospheric and aerodynamic experiments. Retired from flight in 1981, it was cut in half lengthwise and used for wind tunnel tests at the Langley Research Center at Moffett Field where it was dubbed the 'F-53'.

Above right: Performance of the F-106B was very close to that of the F-106A. The basic dimensions were the same and the take-off weight of the B was 500 lb (227 kg) greater, giving a slightly longer take-off run, lower rate of climb and service ceiling, but the same maximum speed. Note the wing fences in this view of the first aircraft taking off from Edwards.

With its 1.5-kT W-25 warhead, the Genie (much like the later AIM-26A Nuclear Falcon carried by the F-102 but not the F-106) imposed burdensome requirements on ADC. In order to operate nuclear weapons, ADC had to create and manage a PRP (Personnel Reliability Program) to exercise control over who had access to 'nukes'. Throughout the USAF, anyone who dealt with 'nukes' had to be screened for PRP and the access was made a part of the individual's medical records. Midway through its career, when it became an ANG aircraft, the F-106 retained its Genie capability but the weapons were no longer readily accessible at air base 'special munitions' facilities. The decision to use an atomic weapon projectile aboard an interceptor reflected the thinking of the time; under today's rules, nuclear weapons would not be released to ANG personnel.

Top secret

Apparently because of the Genie (though possibly with the advanced technology of the MA-1 system in mind, as well), the F-106 was for several years the only aircraft in USAF inventory having a cockpit layout and a flight manual (known in jargon as a 'Dash One') that was classified 'SECRET'. There were strict rules for the possession and handling of classified documents, which were rarely a problem when operating from home base (as the F-106 did most of the time), but which became a nightmare on even the most routine cross-country flight. Pilots were required to obtain special clearance before filing even the most routine flight plan. These rules may have been placed into effect in the expectation that Delta Darts would travel around the country while carrying Genies; in fact, Genies were never carried on routine flights or on cross-country navigation trips. The PRP programme and the security rules were often more of a nuisance than a benefit.

The Genie, which Douglas Aircraft began developing in 1955, occupied a special place in the US arsenal. The Los Alamos, New Mexico National Laboratory designed the nuclear warhead. The Genie was unguided, relying on the power of its nuclear warhead to ensure a kill. It was powered by a 36,600-lb (162.78-kN) thrust Thiokol TU-389 rocket motor, also called the SR-49-TC-1. Launch weight was 822 lb (373 kg), and maximum velocity was about Mach 3.3. Flick-out fintips gave the Genie stability in flight and corrected for roll and gravity drop. Range of the Genie was about 6 miles (9 km). Lethal radius of the blast from the warhead was estimated at 1,000 ft (309 m).

Weapons bay

The F-106 carried its armament in the underside of the fuselage, housed in a single bay that was closed by pneumatically-operated double-folding doors. The bay had missile-launching mechanisms in both the forward and aft sections, from which the Super Falcon missiles were usually fired in pairs. A typical launch sequence consisted of the following actions: doors open; launchers extend; missiles fire; launchers retract; doors close. ADC doctrine held that the F-106 would be vectored to its target using the SAGE system and would make passes of the 'lead collision' type. "The intercept flight path and armament launching will be computed automatically in the execution of this type of attack," read a document of the 1950s. "If a lead-collision pass is not practical, the pilot may set up the fire control system for pursuit mode passes. In pursuit mode passes, the pilot must prepare and launch the armament by operating the trigger on the flight control stick." In an emergency, the pilot could select 'salvo' to jettison all missiles at once.

When the SAGE datalink system was in use, airspeed/altitude commands came up on the instrument

An open day in August 1960 gave the 94th FIS a chance to show off one of its newly-assigned F-106Bs.

dials (later, on the vertical tape instruments). A Tactical Situation Display (TSD) showed a bird's eye view of the intercept situation. The MA-1's pulse radar system was difficult to use compared to the pulse-Doppler radar systems of today because it required a lot of tuning out ground return and short-range contacts, but it was a major advance in its time.

The combination of F-106 Delta Dart, MA-1 fire control system, and Super Falcon missiles and Genie rocket was viewed by ADC commanders as effective in all three combat regimes prescribed by ADC doctrine: Area Intercept (General Defence), Point Intercept (Local Defence), and Free-Lance Air Defence operations outside normal contiguous radar coverage. Pilots were expected to operate at the same level as their targets when possible. When the target – that is, the approaching enemy bomber – was too high either because of a late scramble or because it enjoyed better altitude capability (unlikely), the 'Six' pilot was expected to use a 'snap up' manoeuvre to fire his weapons. Much enamoured of their mission, ADC public information officers in the 1950s put out a brochure aimed at getting school children to memorise the command's mission in the form of an acronym, DIID (detect, identify, intercept and destroy). What most Americans and apparently many intelligence officers did not know at that time was that the Soviet Union's bomber force was less formidable than believed, while the ICBM (inter-continental ballistic missile) was soon to emerge as Moscow's strategic weapon of choice.

Exactly two months after the prototype F-106A began flying, the second ship (56-0452) made its initial flight at Edwards. The first flight of a 'Six' by an Air Force pilot occurred two months later, on 29 April 1957.

The test and developmental work on the F-106 was divided into no fewer than six 'Phases', which began with a rudimentary look at flying characteristics and continued all the way to transforming the new aircraft into a battle-ready, integrated weapon system. Phase I (described by one expert as little more than proving the F-106 airworthy) was to be conducted by the contractor and Phase II by the Air Force. The two prototype F-106As (56-0451/0542) assigned to the Phase II Flight Evaluation at Edwards differed from production Delta Darts in six ways:

– The test aircraft had YJ75-P-1 engines installed instead of the J75-P-9 engines scheduled for early production aircraft and the -17 engines found on late production F-106s and retrofitted to many early ones.

– The engine inlet duct of the test aircraft had a larger capture area (1,050 sq in/6774 cm^2 instead of 1,000 sq in/6451 cm^2). The inlet duct of the test aircraft was aligned

One of the early improvements to the F-106 weapons system, as with the F-102A, was the addition of an infra-red search and track (IRST) sensor. This was a retractable unit forward of the windscreen. The prototype unit was tested on 56-0457, seen here, and featured a prominent raised housing larger than that adopted for production.

Production line

Convair's Plant 2 at Lindbergh Field, San Diego built all 340 F-106s. During the war, the same factory churned out 7,500 examples of the B-24 Liberator and PB4Y Privateer series with a production rate that peaked at 270 aircraft *per month* in March and May 1944. Production of the F-102A did not finish until September 1958, well after F-106A volume production had begun. At the same time, the company was venturing into the civil market with the ill-starred CV-880 jetliner, all at the San Diego complex. The Delta Dart was the last military aircraft built at the plant, in a quantity of one-third that originally ordered. Deliveries peaked in Fiscal Year 1960 (1 July 1960 to 31 June 1961) when 150 F-106As and 36 F-106Bs were accepted by the Air Force at a flyaway cost (F-106A) of $4.9 million per aircraft. The cost could be broken down into: airframe, $2.2 million; engine (installed), $274,000; avionics $1.35 million; armament system, $1.09 million; and ordnance, $24,000.

Right: This view of the San Diego plant shows F-106 production in early 1958 . The first aircraft fully visible is build no. 19, 57-0229, delivered in June 1958 and destroyed in a crash the following April while with Systems Command. Further along are some of the first F-106Bs, mixed in the production line with the single-seaters.

Below: The first F-106A to make its maiden flight from the factory, 56-0454, lifts off from Lindbergh Field on its delivery flight to Edwards in November 1957.

Above and above right: Part of a sequence shows an ejection test of the Convair 'B' seat from an F-106B of AFFTC at Edwards. Note the seat rotation in the second photo.

The gas-operated stabilising arms can be seen attached to the seat frame following another test ejection. Clearance of the fin at supersonic speed was a goal of the designers, but one not always achieved, in the test programme at least.

The Weber F-106 seat undergoes a test, apparently at a relatively low speed. A relaxation of the requirement for ejection at the high extremes of the flight envelope allowed the adoption of this effective seat, which was quickly fitted throughout the F-106 fleet.

The aircraft used for the majority of ejection trials was the first F-106B, 57-2507, seen here in 1970 at El Centro. At one time it also wore a predominantly white scheme.

Ejection Seat

The quest for an ejection seat suitable for the high-Mach, high-altitude flight regime for which the F-106 was designed occupied much energy at San Diego and Edwards. The original design was replaced by the 'B seat', which was overcomplicated and unreliable. Frustrated with the 'B seat', the USAF contracted Weber Aircraft, known for its spacecraft escape systems, to produce a 'zero-zero' F-106 seat. This it delivered in a remarkable 45 days, and the new seats served until the last F-106 was retired.

This is a rocket-sled test of the Convair 'B seat' at Holloman. Such tests propelled test seats to a high velocity for launch without risking an aircraft. Weber proved its F-106 seat with a live 'zero-zero' ejection test in 1965, the only one conducted in the US by an American company.

with the fuselage reference whereas the duct of the production 'Six' would have an inclination 5° down from the fuselage reference line.

– The 'case XIV' wing of the prototype had the leading edge cambered to 10 per cent of the local semi-span with a design coefficient of 0.166 at Mach 1.0 where the production F-106 would have a 'case XXIX' wing with the leading edge cambered to 20 per cent of the semi-span and a design lift coefficient of 0.215 to Mach 1.0.

– The prototype was designed for a side stick installation (foreseeing the future F-16 Fighting Falcon) but a kit modification to a centre stick installation was made prior to the Phase II Evaluation. Production F-106s were to employ the traditional centre stick between the pilot's knees.

– The electrical system of the prototype was powered by an air turbine motor whereas the production F-106 would use a constant speed drive.

– The prototype F-106A during Phase II had its engine inlet pressure sensor, longitudinal control system trim servo, and automatic fuel transfer system (which controlled C of G during supersonic high altitude flight) disabled.

Even with their minor differences, all of the early F-106s were stellar performers. Convair pilot Johnson spoke of heading for the stratosphere in the aircraft: "A full-thrust climb is done on one's back – almost. During the early part of the climb, the feet are as high as the head. One needs to be doubly prepared when doing this on instruments. The F-106 will get to 35-40,000 ft about 30 seconds ahead of you, but with a maximum effort you can catch up by 50,0000." As for returning to earth, Johnson noted that,

A little-known user of the F-106 was the 6520th Test Group at Hanscom Field, Massachusetts, part of the Electronic Systems Division of ARDC. It operated a pair of F-106As between 1959 and 1961 alongside F-102s. One of its aircraft is seen above on a visit to Logan Field, Boston in 1959.

"the only let-down problem is to stay subsonic. Idle thrust and speed boards [the speed brakes located at the rear leading edge of the fin in the same enclosure as the drag chute, usually opened just before the downwind leg in the landing pattern] assure this with ease. The speed brakes can be used at all speeds and are quite effective."

No-one ever said the F-106 was easy to land, but Johnson set forth his rule for getting down safely in an aircraft that had a rapid sink rate and approached at a high angle of attack: "Fly the correct speed on a properly placed glide slope of 2.5-3°, day or night, foul or fair, and you will [land safely]." The F-106 employed a drag chute to retard roll rate on landing.

Phase II tests

The Air Force pressed ahead with Phase II flight evaluation between 22 May 1957 and 29 June 1957. Officially, the purpose of the test was "to obtain preliminary performance, stability, and control data and qualitative information on the handling characteristics of the airplane." Korean War ace Captain Iven C. Kincheloe was the project pilot. Phase II included nine flights (7 hours 5 minutes) on 56-452 to obtain performance data and five flights (5 hours) on 56-451 to obtain stability and control data. Ten additional flights were performed at Edwards for an evaluation of the new aircraft by pilots of the AFFTC (Air Force Flight Test Center), the Air Proving Ground Command (Eglin AFB), Air Materiel Command (Wright-Patterson AFB) and, of course, the intended user of the new interceptor, Air Defense Command (Ent AFB, Colorado).

The early test effort revealed a number of problems with the F-106 design, all minor in nature, including a need for an engine inlet duct with sharper lips and thinner wall, and major changes to the ejection seat (a problem which was to resist solution for some time to come, perhaps in part because the original design had been undertaken as an offshoot of the complex, ambitious seat design in the B-58 Hustler). Kincheloe and project engineer Willie L. Allan said in their summary of the test, among other things, that, "the F-106A performance is lower than that predicted by the contractor. The airplane is capable of approximately 1.8 Mach number in level flight at 36,000 ft [10972 m] under standard day conditions (as compared to a predicted Mach 2 capability). The maximum power combat ceiling is 53,000 ft [16154 m], 2,400 ft [732 m] lower than predicted, but an altitude of 60,000 ft [18288 m] was reached briefly from a zoom climb initiated from 1.7 Mach number at 40,000 ft [12192 m]."

In 1963, these 438th FIS aircraft were seen overflying terrain uncharacteristic of their home state of Michigan. The configuration of the aircraft, however, is typical of early-period F-106s. At least three of the aircraft have the production IRST sensor and all carry the original subsonic fuel tanks. The aerial refuelling modification (which made a notch in the spine) is still several years in the future.

Ejection seat

Kincheloe and Allan also said that, "the prototype cockpit is unsatisfactory and will require redesign. The ejection seat is inadequate for bail-out at supersonic speeds." Kincheloe's assessment reflected a misapprehension that became deep-rooted in the 1950s as supersonic 'Century Series' fighters entered inventory. Simply put, designers were trying to solve the problem of escaping from an aircraft at supersonic speed when, instead, they should have been looking at what happens 'low and slow' and developing zero-zero capability to allow a pilot to escape at low (or no) speed and altitude. This misunderstanding persisted during development of the Delta Dart.

Prototype F-106s were equipped with a Weber-built variation of the seat used on the Convair F-102 Delta Dagger. It was an open, catapult-only ejection seat which used an explosive charge to get out of the aircraft. The pilot wore a standard BA-18 parachute as a backpack. With this original, catapult-only seat, significant altitude and airspeed were needed to make the seat work. When it worked right, the pilot would be moving at 40 ft (12 m) per second at the top of the rail while exiting the aircraft. The original seat was not to last long, and production aircraft were scheduled to receive the Convair 'B' seat, itself soon to become

This view of the Tyndall ramp on a dull day in 1967 is notable for the single all-white F-106B among its grey brethren. It is thought that the aircraft was participating in high-altitude camouflage tests. At least one F-106A was similarly painted at the same time.

The first Delta Darts to venture outside North America were a pair of 48th FIS aircraft that visited the 25th Paris air show in June 1963 by way of Prestwick, Scotland. 59-0136 (above) was put in the static display at the show while 59-0124 remained out of sight. This was perhaps the only serious attempt by Convair to market the Dart to European nations.

F-106As of the 84th FIS based at Hamilton AFB, California take on fuel from a KC-135A, possibly as part of a White Shoes/College Shoes deployment to Alaska. The unit participated in two such deployments, in 1969 and 1970.

Air-to-air refuelling

Air refuelling capability came to the F-106 from September 1967 under the first modernisation phase carried out on the aircraft (as opposed to previous piecemeal modification programmes). Unlike other upgrade schemes then under consideration, the refuelling package was adopted quickly and the modification carried out 'in house' by the USAF. At the same time, 'supersonic' wing tanks were acquired and a new TACAN navigation system installed (under a separate contract). These changes, which had been applied to the aircraft of two squadrons by the end of 1967, were just in time to allow the deployment of ADC F-106s to Korea when the *Pueblo* crisis erupted in January 1968.

This is how a New Jersey Guard F-106A appeared to the boom operator of a KC-135. The refuelling receptacle on the spine of the F-106A varied slightly in shape from that of the B. The new unit displaced none of the fuselage fuel capacity, which consisted of a single 227-US gal (859-litre) tank on the F-106A and a 177-US gal (670-litre) tank on the B.

embroiled in controversy. Thus, Kincheloe – who would later lose his life in the downward ejection seat of an F-104 Starfighter – may have been complaining about the wrong seat.

Qualified approval

Test pilots had been trained to tell it like it was, and there appeared to be no strong reason why the F-106 could not evolve into an effective warplane. The Kincheloe/Allan remarks concluded, "Except for the lack of performance, the prototype airplane tested has the potential of being an excellent Air Defense Command interceptor. Satisfactory demonstration of stalls, spin recoveries, inertial coupling, and dead stick landings, as well as an operational fire control system, are required before the aircraft is delivered to operational units."

Kincheloe and Allan made 18 recommendations, ranging from minor changes to the canopy to improved brake pedals. Based on their findings, Convair's Phase III of the development effort included stall, spin and flame-out studies which exceeded those originally planned.

Convair was having difficulties fielding the F-106A and the imminent F-106B, but this did not prevent the company from proposing advanced versions. In 1954, company aerodynamicists R. C. Lingley and R. E. Craig had laid out plans for a delta-winged interceptor powered by two General Electric J79 turbojets, the powerplant used by the company's B-58 Hustler bomber. A 5 November 1957 blueprint illustrates a version identified as the F-106C (no relation to a very real F-106C that was to come later) powered by a single Pratt & Whitney JT4B-22 turbojet, a variant of the J75, and offering a gross weight of 42,140 lb (19114 kg), about 28 per cent greater than the weight of the actual F-106. This was an innovative period for company designers, who were co-ordinating B-58 work in Fort Worth, Texas with F-106 work in San Diego, but none of the advanced F-106 variants was built. The task of manufacturing the F-106 required Convair to gear up with new tooling and fixtures on a separate production line while some F-102s were still being built. Final assembly still took place on the line in Building 3 at San Diego, and initially just 1,500 employees worked on the 'Six' while 7,000 continued to manufacture F-102s. The number of employees on the F-106 alone eventually rose to 11,851. During this era, as it nudged into the ballistic missile business, Convair employed 40,000 people and was dearly loved in southern California. General Dynamics had owned Convair (always officially known as the Consolidated Vultee Aircraft Corp.) since 15 May 1953, and in May 1961 the parent firm began using its own name in tandem with the Convair appellation.

ADC hoped at one juncture to acquire 1,000 F-106A fighters to equip no fewer than 40 combat squadrons. A decision was eventually reached (in September 1958) to

A 5th FIS Delta Dart taxis in at Buckley ANG Base in July 1971. As well as showing the early 5th FIS markings, this photograph reveals the IRST sensor in extended position and the optical sight for the Genie rocket mounted at the top of the windscreen. This device was later removed.

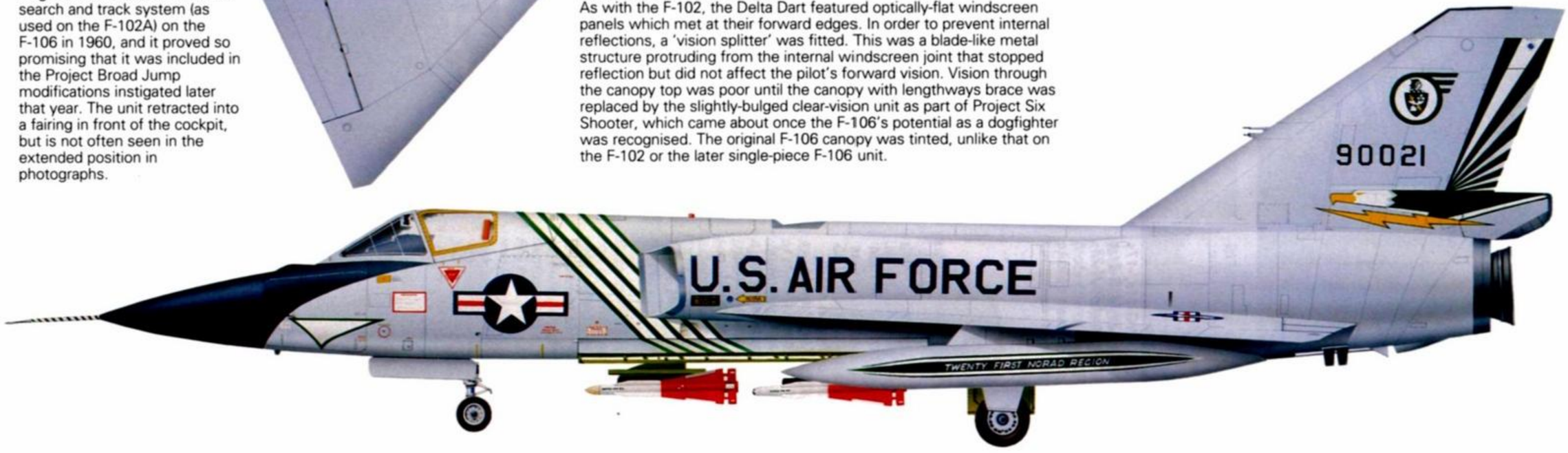
Convair F-106A-CO-105 Delta Dart
49th Fighter Interceptor Squadron
Griffiss AFB, New York, 1973

Super Falcon missiles
Originally designated XF-98 and then GAR-1, the AIM-4 Falcon was the first air-to-air guided missile to enter service with any air arm. The AIM-4E was the first of the 'Super Falcons', introduced in 1958 with a longer-burning motor and a larger warhead. F-106s could carry four Super Falcons, often a pair of radar-guided AIM-4Fs (in the front bay here) and a pair of infra-red-guided AIM-4Gs (rear bay). This only gave a two-shot capability, however, as the missiles were always ripple-launched in pairs. Unlike Soviet practice, the Falcons were not fired in mixed pairs (IR and radar) and the IR missiles were fired first so that they did not guide on the previous pair rather than the target. The F-106 was the last US fighter to carry AIM-4s, other platforms including the F-102, F-89 and F-4.

59-0021
Delivered on 8 February 1960 to the 319th FIS at Bunker Hill AFB, this particular F-106 was number 186 on the San Diego production line. On 9 March 1963, it was assigned to the 438th FIS at Kincheloe AFB, which relocated to Griffiss AFB in August-September 1968. On 30 September, the unit was redesignated the 49th FIS. The aircraft was assigned to the commander of the 21st NORAD Region, headquartered at Fort Lee, Virginia, which covered the eastern United States. On 15 May 1973, it crashed, following a lightning strike, killing Major General James D. Price. General Price was the instigator of the Six Shooter project, but his aircraft was one of the few that had not undergone the modifications by this date.

IRST
Hughes first tested an infra-red search and track system (as used on the F-102A) on the F-106 in 1960, and it proved so promising that it was included in the Project Broad Jump modifications instigated later that year. The unit retracted into a fairing in front of the cockpit, but is not often seen in the extended position in photographs.

Windscreen and canopy
As with the F-102, the Delta Dart featured optically-flat windscreen panels which met at their forward edges. In order to prevent internal reflections, a 'vision splitter' was fitted. This was a blade-like metal structure protruding from the internal windscreen joint that stopped reflection but did not affect the pilot's forward vision. Vision through the canopy top was poor until the canopy with lengthways brace was replaced by the slightly-bulged clear-vision unit as part of Project Six Shooter, which came about once the F-106's potential as a dogfighter was recognised. The original F-106 canopy was tinted, unlike that on the F-102 or the later single-piece F-106 unit.



Above: The 95th FIS arrived in November 1969 to take over the alert commitment. The operational tempo and environment of the Korean theatre was in contrast to that normally faced by ADC crews.

Above: Watched by the commanding officer of the 94th FIS, Lt Col Joe Olshefski, his counterpart in the 95th FIS, Lt Col Roy White, completes the paperwork for the handover of Osan alert duties to his unit on 15 November 1969.

AFB, New Mexico for ejection seat trials. This marked the beginning of difficult tests of the controversial Convair 'B seat'. On 29 June 1960, the first aft dummy seat ejection was made and resulted in damage to the vertical fin of 57-2507, one of many vicissitudes along the way.

Two-seat testing

The similarity between the F-106A and the F-106B meant that only a very limited Phase II programme was intended for the B model. Four F-106Bs were employed in this effort at the AFFTC (Air Force Flight Test Center) between January 1958 and about April 1959.

The number three F-106B (57-2509) was assigned to AFFTC for Phase IV testing (the intermittent Phase II also was performed by the contractor). This aircraft was the first F-106B incorporating the production wing ('case XXIX' delta) and the production longitudinal and lateral control system (centre stick). Tests consuming 60 hours of flying time began in May 1958.

A combined phase/test utilising both the F-106A and F-106B began in May 1958 with four F-106As and two F-106Bs assigned. The 10-month Phase VI effort consumed 150 flight hours and marked the first time the Delta Dart would be evaluated as an integrated weapon system rather than merely a flying airframe – replete with MA-1 AWCIS. This period marked the first loss of a 'Six' – on 27 May 1958 – when a JF-106A (57-0242) crashed at Edwards. Aircraft assigned to this phase were F-106As 57-229 (in May 1958), 57-231 (June 1958), 57-234 (July 1958), 57-235 (August 1958) and F-106Bs 57-2511 and -2512 (in August 1958). Phase VI included test firings of GAR-3A and GAR-4 Super Falcon missiles and MB-1 Genie projectiles at Holloman AFB, using two of the F-106As. Also included in this effort were runway barrier tests.

Included in Phase II development of the F-106 was the Armament and Airborne Weapon System Development (AAD) effort undertaken in 1959 at Holloman AFB, where tests were also conducted with the F-106 ejection seat. As part of the overall Delta Dart effort, numerous aircraft were to undergo 'testing to tactical' modification, transforming them from developmental to operational aircraft – and Holloman was also tasked with validating the results of these modifications.

Unbuilt Darts

Convair put in considerable work on an F-106 'fighter-bomber', with and without tactical reconnaissance capability. One proposal for a two-seater based on the eventual F-106B called for a set of three KA-8 cameras with 9x9-in (23x23-cm) film capacity for terrain identification, target identification, and bomb damage assessment. Several versions of an ECM (electronic countermeasures) pod were recommended for this Delta Dart variant.

Convair also proposed the F-106A 'Economy Fighter Bomber' capable of all-weather navigation and high-resolution radar bombing of fixed targets. This aircraft

95th FIS Darts sit on alert at a damp Osan. Note the different shade of blue used in the squadron markings.

Above: Towards the end of the 95th FIS's deployment to Korea, in April 1970, it looked like the 95th's six-month tour was going to be extended past the 1 May 1970 arrival home date – hence the 'screwed' patch.

Below: F-106s of the 94th top up with fuel on their return to the US following their Korean sojourn. The initial deployment of the 71st FIS to Korea in 1968 marked the first deployment of the F-106 using inflight refuelling.

Above: Live AIM-4s are unpacked for loading onto a 95th FIS aircraft. It is not thought that the AIR-2 Genie was taken to Korea, although USAF fighter-bomber units were at nuclear readiness.

Pueblo crisis

With increasing commitments in Vietnam, US air strength in South Korea was run down to the point that it was found severely lacking in 1968 when the North Koreans captured the USN spy ship USS *Pueblo* on 23 January 1968, triggering the worst crisis since the end of the Korean War. This event, and the ongoing detention of the crew, led to the deployment of B-52s to Okinawa and F-100s, F-105s and RF-101s to bases in South Korea, as well as the stationing of USN carriers in Korean waters. Due to a particular lack of interceptor aircraft, F-106s of ADC were sent to Osan to bolster local air defences under the codename of College Cadence, beginning in February 1968 with the deployment of the 318th FIS. It was followed by the personnel of the 48th FIS in July 1968, who used the 318th's aircraft and flew home in them on 23 December (the day the *Pueblo* crew were released) to be replaced by the 71st FIS. The 71st made way for the 94th FIS in June 1969. Further tension, including the shooting-down of an EC-121M of VQ-1, led to an extension of the deployment. The 94th handed the duty to the 95th FIS on 15 November 1969 and flew back to the US. Finally, the Joint Chiefs of Staff recommended an end to College Cadence deployments to Korea on 16 April 1970, and the 95th FIS returned home to Dover AFB, Delaware on 1 May 1970.

Above: A pair of 94th FIS aircraft patrols over the lush fields of South Korea. The threat from the North Korean Air Force in 1968 consisted of over 500 MiG-15s, -17s and -19s and 30 MiG-21s, as well as about 60 Il-28 bombers.

Right: The 318th FIS was the first F-106 unit to deploy to Korea, staging through Naha, Okinawa. Here, a 318th FIS F-106A stands guard at Osan as a Naha-based 815th TAS C-130A brings in more supplies. The* Pueblo *crisis stretched USAF resources as the bulk of tactical assets were at that time committed to the Vietnam conflict.

reduce this to about one-third. For much of the Delta Dart era, ADC operated a dozen squadrons, a figure that peaked briefly at 14. The TO&E (Table of Organisation & Equipment, i.e., authorised strength) of a squadron began at 18 aircraft but changed several times over the years, once reaching 24.

Built for two

The first two-seat F-106B (Model 8-27) aircraft (57-2507) flew at Edwards on 9 April 1958. The F-106B tandem, two-place Delta Dart was intended as a two-seat weapon system proficiency trainer and transitional trainer, although in later service it would sometimes be employed simply as an interceptor with two seats. The front cockpit duplicated the front cockpit of the F-106A. The idea was to duplicate all necessary flight controls for transition in the rear cockpit, and armament and other internal systems would be identical.

The B model was expected to have a somewhat reduced speed and ceiling because of its added weight, but it turned out to perform almost exactly like the F-106A. The first two-seater was used initially for spin tests and stall investigation, underwent minor modifications, and returned to Edwards on 29 June 1959 for further tests. On 30 September 1959, it underwent a high-speed taxi test to investigate nosewheel shimmy, during which the aircraft caught fire and sustained considerable damage. It was trucked to San Diego on 14 October 1960 for repair and returned to flying status on 29 April 1960. Beginning on 7 May 1960, F-106B 57-2507 was employed at Holloman

Left: The F-106 bomber: the Delta Dart never actually flew with dedicated air-to-ground ordnance, but one aircraft of the 48th FIS (still wearing 318th FIS marks) at Osan in 1968 was fitted with a pair of multiple ejector racks and a dozen Mk 82 bombs. It was all part of a joke for ADC CO General Agan, who was inspecting the farthest reach of his command.

Below: F-4Cs of the 80th TFS, 347th TFW share the ramp with 71st FIS F-106s. The* Pueblo *deployments were relatively uneventful for the tactical units involved, although the 95th FIS lost an aircraft and pilot in 1970.

A pair of 71st FIS F-106As is seen in 1967 with the minimal markings of a small fin badge worn for a time by this unit. This was about as 'low vis' as F-106 unit markings ever got, and the 71st later adopted a medium-blue chevron as a field for their badge.

would have had a new search and bombing radar and the capacity for a 'special weapon', a tactical nuclear bomb. This 'TAC Economy Model' (Tactical Air Command) would have had an inflight-refuelling 'socket' (receptacle) located forward of the pilot – more than a decade before real F-106s actually got one, in a different location behind the pilot – and would have carried a 2,000-lb (907-kg) 'special weapon' internally with an alternate load of two 90-US gal (340-litre) fuel tanks and a 1,000-lb (454-kg) conventional bomb. The 'Economy Model' was limited to a gross weight of 40,000 lb (18144 kg) to maintain the existing F-106 landing gear without redesign.

A higher-cost, two-seat version of the same concept would have had strengthened undercarriage, additional avionics, internal provision for a 2,000-lb (907-kg) 'special weapon' or two 65-US gal (246-litre) fuel tanks, one 1,000-lb (454-kg) conventional bomb, and two Sidewinder missiles. A Convair report noted that, "TAC pilots have performed LABS [low altitude bombing system] manoeuvres in this aircraft without difficulty."

Twin-engined Dart

Convair engineers also worked on a proposal for an F-106 powered by a single Pratt & Whitney J58 turbojet, and on a 'twin-engined version of the F-106-30 all-weather interceptor' which would be powered by two General Electric J93 (X-279E) engines. Both would have had gains in acceleration, rate of climb, and altitude capability as compared to the production F-106. The twin-engined F-106-30 had a two-man crew (pilot and radar operator/navigator) and had its engines slung under the wing in pods identical to those employed on the B-58 Hustler. A horizontal tail surface was also added. The fire control system was a conceptual Hughes # 5082 pulse-Doppler radar and armament was two GAR-9 missiles, an advanced version of the Super Falcon.

While the USAF was testing, developing and fielding the Delta Dart, Convair was trying to expand sales. The company considered the possibility of arranging an alternate production source (Lockheed or Canadair) for a Canadian version – not merely an interceptor variant, but an 'F-106 strike aircraft (RCAF)'.

There was also a detailed plan for F-106 final assembly and production in Germany, in partnership with Convair. A company memo dated 1 August 1959 talks of the difficulty of arranging F-106B orientation rides for Belgian and Netherlands pilots flying F-104s at Edwards. These pilots, the memo complained, were being "kept under wraps by Lockheed."

Below: To commemorate the feats of Eddie Rickenbacker 50 years before, a SPAD XIII was displayed at Andrews AFB with a 71st FIS F-106A in 1968. The Dart wears a William Tell special colour scheme and the pilots wear the flying gear of their respective periods.

A different memo on the same date relates to preparing brochures for an F-106 version for Japan "with MG-10 fire control system [the system used on the F-102A Delta Dagger] and six Super Falcon missiles in lieu of the normal four-and-one (four Super Falcons and one Genie) armament." One company official, the memo reported, "has convinced everyone here that the sale is 95 per cent made."

'Multi-purpose' F-106

The manufacturer's efforts to snare Japan as a customer, as with Canada, included sketching out a version with air-to-ground attack capability. The Japanese concept had two pylons on each wing: the outer was capable of carrying on each side a 450-US gal (1703-litre) fuel tank, a 2,000-lb (907-kg) bomb, two 1,000-lb (454-kg) bombs mounted in tandem, or other weapons; the inboard would have accommodated on each side a 230-US gal (870-litre) fuel tank, a 1,000-lb (454-kg) bomb, two AIM-9 Sidewinder IR missiles or a gun pack. The Japanese multi-purpose F-106 would have had internal capacity for additional fuel or two 1,000-lb (454-kg) bombs, or three Sidewinders, or four Falcons, or two Falcons plus two Sidewinders, or a reconnaissance camera package. A separate document envisioned an armament package of 2.75-in Mighty Mouse unguided FFARs (folding-fin aircraft rockets) of the kind employed on the F-86D Sabre, F-89J Scorpion and F-94C Starfire. The planned export MG-10 fire control system would have been compatible with all of these weapons. A key sales point was that the MG-10 was a proven system (aboard 1,000 F-102s) and that the Japanese version would be interchangeable "with the fire control systems now being used in USAF F-102 interceptors now in Japan."

Air Defense Command practised dispersal of interceptors, and for many years one or two F-106s could be found in alert barns in some unlikely places. This 5th FIS F-106A was spotted at Davis-Monthan (later the temporary home of most of the surviving F-106s) in April 1979.

Below: Large formations were not part of the F-106's business, but this 16-ship from the 87th FIS was captured in 1969. Squadron establishment in the last years of the 'Six' was 15 aircraft; it was as high as 24 at one point.

Left and below: ADWC F-106Bs fly over Panama City, west of Tyndall AFB. The lower aircraft wears the fuselage stripes of the 2nd FITS squadron commander and the earlier type of fin markings worn by the ADWC.

ADWC-Tyndall

The Air Defense Weapons Center (ADWC) was formed at Tyndall AFB, Florida in November 1967. The base had been in ADC hands since 1957 with the 4756th ADW as the main flying unit, operating the F-101, F-102 and F-106 for transition training and the development of new weapons and tactics, tasks continued by the ADWC. In 1978 an Air Combat Manoeuvring (ACMI) range was opened, as was a new runway ('droneway') for drone operations. A large number of F-106s were assigned to the ADWC/4756th ADW at some point during their active careers, and many of them returned later as drones.

Above: F-106s of several ADC units are visible in the background, along with PQM-102s, on the ADWC flight line during William Tell 1972. The ADWC operated both F-106As and Bs, along with F-101Fs, as seen here.

Above left: This ADWC F-106B photographed in 1974 wears only minimal markings of an ADWC badge on the fin.

The Japanese sale never took place, however, and a few years later Japan manufactured F-4EJ Phantoms.

In May 1958, the USAF took delivery of two F-106Cs (57-0239/0240) with a 40-in (102-cm) nose radar dish (with no other change to the MA-1 system). The dish had been part of the initial MX-1179 concept but operational F-106s, which had a capacity for a dish of up to 28 in (71 cm), actually used 23-in (58-cm) examples. They were tested until October 1958, but the F-106C configuration was not chosen for a production contract. Had there been a production order, the proposed F-106C would have had a new engine, a new fuselage structure, and several technical changes. Convair was looking for a minimum purchase of 350 aircraft (10 more than the eventual F-106A/B buy, as it turned out). Of the two F-106Cs, only aircraft 57-0239 actually flew. This aircraft was subsequently destroyed in fatigue tests. Aircraft 57-0240 reverted in due course to standard F-106A configuration and later served with the New Jersey ANG and, still later, as a QF-106A drone.

The company was also working on a variant designated F-106D, which may simply have been a two-seat C model. Both the F-106C and the F-106D were deleted from the continuing Delta Dart developmental programme on 23 September 1958.

Rider on the storm

In 1959, the US Weather Bureau formed a National Severe Storms Project (NSSP) known colloquially as Project Rough Rider. This joint civilian/military project involved the USAF, NASA, FAA, and colleges and research centres in an ongoing investigation of the causes and effects of severe thunderstorms. Aircraft committed to the programme included a B-47 Stratojet, F-100F Super Sabre and T-33 Shooting Star. An F-106A (57-0234) was supplied to the project and was modified with a metal nosecone for protection against hail, the intercept radar being removed from the aircraft. The nose pitot boom was modified with balsa vanes for measuring of air turbulence. The missile bay was filled with a special instrumentation package designed by NASA's Langley Research Center.

The USAF's interest in this weather study were not strictly meteorological: it wanted to evaluate the all-weather capability of its new interceptor and to assess the effects of water and ice ingestion in a jet engine at high Mach air speed. Beginning in May 1961, the F-106A flew 18 thunderstorm penetrations; during one, Major Jake Knight flew through the core of a thunderstorm at Mach 1.22. In September-October 1961, Rough Rider penetrations were mounted from MacDill and Homestead AFBs in Florida. It appears that the Delta Dart was used in this programme only during the 1961 season.

B for Bobsled

By the time operational service was on the horizon, the original ejection seat of the F-106 was gone and the aircraft was equipped with the Convair 'B seat'. The letter designation may have lacked special meaning, but pilots believed the seat was so-named because, when activated, the seat resembled a bobsled. It focused on ejection at supersonic speed (as recommended by the project test pilot and engineer), which was to prove, in due course, a worse choice

Above: The M61A1 gun package disturbed the clean lines of the F-106 but helped fulfil its potential for fighter vs fighter combat.

Right: The ADWC carried out the bulk of operational testing on the gun installation and other Six Shooter modifications. Seen with a BQM-34A is 58-0795, which sports 10 drone 'kill' marks.

Six Shooter

As early as 1967, the F-106 was recognised as having great potential in the fighter-vs-fighter role. Project Six Shooter, instigated by Lt Col Bob Archibald and managed by General James Price, centred around the installation of a 20-mm M61 Vulcan cannon in the rear of the F-106's weapons bay. Money for the Six Shooter modifications was authorised in 1969 following the Six Gun tests at Edwards. These trials, which cost $1.7 million, resulted in the adoption of a number of other improvements as well as the gun, including a lead-computing gunsight and a clear-topped canopy. The ECCM (electronic counter-counter measures) and RHAW (radar-homing and warning) gear requested by ADC were not funded and testing of the other modifications was not completed until mid-1972. Not all aircraft were fitted with the Six Shooter modification package, which effectively replaced the Genie capability, although the gun could be removed or replaced in about eight hours.

Above: One of the original F-106 'gunships' is seen at Edwards during the 1969 Six Gun tests. The clear-topped canopy was installed as part of these early tests.

than the original seat.

The Convair 'B seat' (manufactured in Denver and Colorado Springs, both in Colorado, by Stanley and Aircraft Mechanics, respectively) was a rocket-powered, open-type, upward ejection seat. It was designed (in 1957) to incorporate suggestions by a joint USAF/Industry Crew Escape System Committee. The seat was subsequently installed in F-106A/B aircraft to conform to "the original requirement for escape capability within the airplane mission profile" – bureaucratic language which means that planners seriously expected pilots to bail out without slowing down first. It was the first USAF ejection seat designed specifically for supersonic escape, so emphasis was placed on high-speed fintip clearance, windblast protection, packaging of the seat occupant, and retention of equipment. The seat's performance was demonstrated in 15 sled tests and 11 flight tests, mostly with dummies. One flight test (presumably using F-106B 52-7507 at Holloman) was conducted by ejecting an Air Force officer at 22,580 ft (6882 m) and 337 kt (388 mph; 624 km/h) IAS. Surviving records reveal that another test was made from 84,150 ft (25648 m) using a dummy, but do not disclose how that altitude was reached.

It quickly became apparent that one had to be 'a dummy' to want to eject from an F-106 using the 'B seat'. The 'ejection sequence' – actually using the seat to get out of the aircraft – was a nightmare. The pilot began the ejection sequence by pulling a D-ring; this jettisoned the canopy, retracted and locked the shoulder harness, retracted the occupant's feat, and raised the foot pans, seat pan, and leg guards. Thus, in the middle of the ejection sequence, the pilot was trussed into his seat with no use of his arms and legs. Incredibly, the pilot then was expected to pull on the D-ring a second time to disconnect the seat actuator and fire the seat's vertical thruster. (On two-seat F-106Bs, the two seats were interconnected so that the rear seat had to complete all this before the front seat could eject.) Once the vertical thruster had propelled the seat up its rail, two rotational thrusters were supposed to fire, causing the seat to rotate into a horizontal position on top of the aircraft. Once horizontal, gas-operated stabilisation booms were to extend, four breakaway attachment bolts were to fire and the rocket was to ignite, propelling the seat away from the aircraft.

The old, the very old, and the new fly together in April 1975. The KC-97 was a descendant of the B-29 designed in 1940, and the F-15 will still be in US service in the 2020s. The last KC-97s were retired in 1978 (by the Texas ANG), by which time the F-15A had replaced the F-106 in most of the regular FIS squadrons.

Live ejections

The first test ejection with the toboggan-like 'B seat' involving a live human being was made by Technical Sergeant James A. Howell of the 6511th Test Group at El Centro, California on 6 June 1961. Wearing a partial pressure suit, standard boots and an MA-3 helmet, Howell ejected from an F-106B piloted by Major James Hendrix at 558 mph (898 km/h). Shortly after Howell's live test of the 'B seat', First Lieutenant Win E. Depoorter became the first man to save his life in an emergency bailout using the rocket-powered seat.

During an inflight emergency on a flight from a base in the northwestern US (apparently in 1964), a pilot began the ejection sequence but the vertical thruster apparently failed to ignite. This left the pilot strapped immobile in his seat, watching helplessly while his F-106 plummeted from high altitude all the way to the ground – with him inside.

Because many F-106s had been used in many configurations during developmental work, the USAF placed great importance on the 'Test-to-Tactical' (T-to-T) modification programme aimed at bringing all F-106s up to a single standard – the configuration which would later be introduced on the production line with the 125th production aircraft.

Nearly 40 airframes were flying before the first 'Six' became operational, and they were in all kinds of 'testing' configurations that differed, usually in minor ways, from the service aircraft. No fewer than 28 F-106As and seven F-106Bs, therefore, underwent the 'Test-to-Tactical'

Cold Fire '75

The one true F-106 deployment to Europe was a participation by the 5th FIS in the NATO exercise Cold Fire in 1975. From 4 to 27 September, seven of the squadron's aircraft were deployed to Hahn AB. Until 1970, the F-102 had been a common sight in Europe, but the Delta Daggers were mainly replaced by F-4 Phantom squadrons.

modification aimed at standardising their features for use in operational squadrons. Of these, 12 were temporarily designated JF-106A and eight two-seaters were called JF-106Bs, the 'J' prefix indicating a modification that could be 'undone' with subsequent changes. The other dozen aircraft did not go through the 'Test-to-Tactical' programme. The prototype (56-451) served briefly as a ground trainer at Amarillo AFB, Texas (beginning 27 January 1960), was assigned to the Air Force Museum on 23 March 1960, and was never equipped with radar, MA-1 system or armament. The second aircraft (56-452) was disposed of in an unknown way: its fate remains unknown and there is no report of it being lost in a mishap, yet it never reached ADC and never went on display.

Also not undergoing the 'Test-to-Tactical' brush-up were the following Delta Darts: 57-0242 (crashed on 27 October 1958), 57-0229 (crashed on 8 April 1959), 57-2511 (crashed on 5 January 1959 and had not been scheduled for 'T-to-T' anyway), 58-0762 (crashed on 23 September 1959), and 57-0239 (intentionally destroyed in fatigue tests ending on 4 April 1960). The final aircraft on the list of Delta Darts that never became operational is 56-0455, the fourth ship built. This aircraft was bailed to Convair for structural fatigue testing either at Edwards or Palmdale. The testing was completed on 31 March 1960 but the disposition of the airframe is not recorded.

An F-106A (left) and a B (above) of the 'Spittin' Kittens' participated in Cold Fire interception missions at Hahn during September 1975.

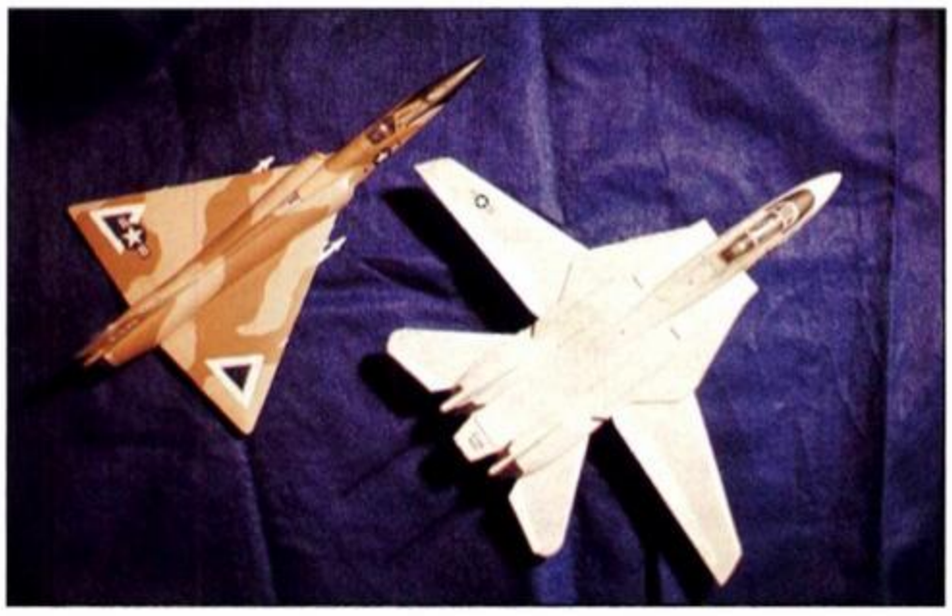
Modifications

The 'T-to-T' modifications were identified by 'Mod' numbers and included: Mod T-1064, covering installation of the J75-P-17 engine, enlarged inlet ducts, increase in fuel capacity, raised pilots console and installation of the supersonic ejection seat (the 'B seat'); Mod T-1065, covering installation of automatic flight control system, air-to-air identification (AAI), and a recorder; Mod T-1066, covering the installation of vertical tape instruments. Among earlier aircraft not manufactured with the tapes from the start, some had the tapes installed at depot level but many never did. The first three operational squadrons of F-106As had round-dial instruments.

While testing, development work and uncommonly troublesome delays characterised the F-106 development effort, Air Defense Command moved to get the new warplane into service. It has been argued among those who were on the scene whether the 'first' F-106 squadron was the 539th FIS at McGuire AFB, New Jersey or the 498th

The 'Six' and the Navy

Despite the failure of Convair to persuade the US Navy to procure a version of the F-106, the USN maintained an interest in the Delta Dart over the years. Conversely, the USAF's evaluation of the Navy's new F4H-1 Phantom II against the F-106 in 1961 led to the purchase of a version of that aircraft for the Air Force. College Dart deployments in the 1970s gave both services the chance to practise dissimilar air combat training (DACT) against supersonic opponents. A USN Aggressor version of the F-106 was even proposed, but this idea came to nothing.



Above: A model of an 'aggressor' F-106A was displayed with that of an F-14A at a Joint Chiefs of Staff briefing in 1973. Note the pylon-mounted AIM-9s and the Israeli-style recognition triangles on the Delta Dart model.

Above: 48th FIS F-106s share the flight line with VF-301 F-4Ns. The idea of the F-106 as a dogfighter was far from that envisaged by Convair and ADC.

Left: 'Beat Navy' reads the inscription on the drop tank of this 49th FIS F-106A seen on a College Dart in October 1971. Note the F-4 'kills'.

Above: 59-0076 of the 49th FIS was noted with several variations of its Bicentennial scheme in 1976. In September, when seen above, it sported red eagle's wings and lightning bolt as well as the coloured leading edge and 13-star flag.

Below: A pair of 318th FIS Darts breaks away from the camera. This view shows the degree of leading-edge camber on the superficially simple wing of the F-106.

Bicentennial birds

The 1976 United States Bicentennial celebrations provided the excuse for some spectacular special colour schemes on US military aircraft. Many aircraft wore the Bicentennial 'pretzel' logo, but units were authorised to paint one aircraft in a special scheme. Three of the F-106 squadrons made a particular effort to commemorate the event, choosing aircraft with '76' in their serials.

Above: 58-0776 was the 318th FIS Bicentennial aircraft, which was inscribed with 'Freedom Bird' on the underwing tanks.

Left and above left: Certainly the most colourful F-106 – and perhaps the most colourful warplane of all time – was 58-0760, the Florida ANG's contribution to the 1976 celebrations, named 'City of Jacksonville'.

FIS at Geiger Field (now Spokane International Airport) in Washington. The best evidence seems to be that the 539th received its first 'Six' on 30 May 1959 and the 498th two days later. Press releases credited the latter squadron with being first, and there is no dispute that F-106s at Geiger Field were ready for combat before those at McGuire.

It would be almost impossible to exaggerate the importance of ADC at the time, or the real-world certainty with which American officers believed they were preparing for the largest air battles ever waged, over American soil. At the height of its efforts to defend North America, ADC had nearly 80 combat squadrons, more than 2,400 combat-ready warplanes, and principal or 'divert' operations at as many as 200 airfields. Nearly 100,000 Americans of all ranks served in ADC in the 1950s. Their flying squadrons were relatively small and were often 'tenant' units on air bases that belonged to other commands (such as the equally vital and prestigious Strategic Air Command) and their 'detachment' and 'divert' locations were often nothing more than a couple of alert 'barn' hangars at a tiny civilian airstrip. ADC was armed to the teeth, enjoyed top priority for new equipment, and was expected to fight. Today, thousands of veterans of ADC believe that their vigilance contributed to preventing an atomic war in the era when the bombs were being tested in the atmosphere, existing nuclear weapons numbered in the tens of thousands, and President Eisenhower and Premier Khruschchev seemed to be in competition to publicly brandish the largest hydrogen bomb.

Nuclear age

It was taken for granted that nuclear weapons were part and parcel of warfare, including air defence. Every new USAF airman was issued a round, black plastic device to hang from a chain around his neck – a dosimeter, which would glow a different colour to tell him how much radiation he had absorbed. The US Army, in those days, was developing Nike (later Nike Ajax) and Nike Hercules air defence missiles, the latter with a nuclear warhead that was shown in tests to be dangerously unreliable – but nonetheless was fielded in a ring around US cities. The two ADC commanders in the 1950s, Generals Benjamin W. Chidlaw (after whom the command's headquarters building was later named) and Earl P. Partridge – who, between them, covered 1951 to 1956 – were gruff, tough combat veterans who regarded a 'nuke' as simply another tool to be employed in the aerial battlefield. Partridge said he would not hesitate to pull the trigger himself, and no-one doubted it: in Korea, he had spent three days flying around in a T-6 Texan dodging a hailstorm of gunfire in an unsuccessful effort to find and rescue a missing American.

No-one hesitated when a plan was developed several years later (in 1959) to provide an F-106 for Operation Trumpet, in which the aircraft would be flown close to an atmospheric nuclear detonation to measure its performance. In the late 1950s, a pilot's protective thermal curtain was routinely developed for the new interceptor, as for many other aircraft in inventory, to enable the flyer to minimise injury from a blinding atomic flash. It is unclear how the plan for Trumpet unfolded (no F-106 ever fired a 'live' nuclear round, although a Northrop F-89 Scorpion did, in the 'John' shot during Operation Plum Bob in the Nevada desert in July 1957). However, expecting USAF pilots to fly close to a nuclear detonation was not exceptional in this remarkable era.

It was also a time when the United States had a clear-cut

foreign policy and had elected civilian leaders who were comfortable with military terms and ready to use military force. President Eisenhower was anything but a hawk, and is remembered today for counselling against some of the excesses of the era (as well as unsuccessfully warning Americans against developing a 'military industrial complex'). Still, 'Ike' routinely signed off plans for such measures as bomb shelters, a suitcase-sized nuclear device to be employed by Navy underwater demolition teams (the future Seals), an infantry weapon with nuclear capability, and just about anything that would help to defend American soil against the expected attack from the Soviet bomber fleet.

As far as the formidable and rather beautiful F-106 was concerned, little was said about its nuclear capability in print, but press releases otherwise reflected the tenor of the times. The F-106 was a "plane with a brain." It was "a marvel created by our hard-working scientists." The mission of the 539th was "the defence of the New York-Washington-Philadelphia triangle against attack by enemy H-bombers." The MA-1 system aboard the interceptor "literally thinks for the pilot, freeing him to make tactical decisions." The MA-1's 'Digitaire' computer was "capable of solving fantastic mathematical problems in a fraction of a second."

Members of the 539th went to Tyndall AFB – the base with which the F-106 would be associated longest – to assist with Category III developmental testing in July 1959. On 21 July the Geiger-based 498th FIS scrambled five F-106s on a simulated combat mission. The new interceptors found and 'destroyed' all targets within 10 minutes of the scramble. Very real F-102As were used as the targets. A historic moment came on 31 October 1959, when the 498th FIS began standing alert as part of ADC's fighting force. ADC practice was to keep interceptors ready to fly in flimsy metal 'barns' near runway's end, with the pilots suited up and ready to go.

Speed record and hands-off flight

It was clear all along that the F-106 was a speedster. This became more clear on 15 December 1959 when Major Joe W. Rogers piloted an F-106A (56-0467) to a world air speed record of 1,525.95 mph (2455.71 km/h). Within days, another F-106A (46-0466) went to Eielson AFB, Alaska to begin two months of cold-weather tests. The latter aircraft was painted in the familiar Arctic scheme of the era, with brilliant red on rear fuselage, wingtips and fin. (Eight months later, upgraded to operational status, Rogers's -0467 was assigned to the 329th FIS at George AFB, California.)

The ability to control the F-106 from the ground was dramatically demonstrated on 30 March 1960. An F-106A (59-0047) flew across the United States with the pilot, Major Frank Forsyth, onboard solely for the take-off and landing. Forsyth lifted off from Palmdale at 11:48 a.m. (EST), flew to Jacksonville, Florida, then landed at Tyndall at 3:46 p.m. (also EST). The flight involved 3 hours 12 minutes' work for the aircraft and five minutes' work for the pilot. The *San Diego Evening Tribune* reported that, "the plane was piloted by a Hughes MA-1 navigation and fire control system. The system does everything except land and take off. The pilot is needed to monitor the system and take over if anything goes wrong." In fact, the USAF had planned an 'automatic' flight from Edwards to McGuire as far back as 4 June 1959, using the term Operation Longlegs, and aborted one attempt flown by Colonel William C. Clark, so Major Forsyth's achievement was nine months in coming.

Even then, Convair press relations employees argued over how to describe the aircraft. It was all right to call it 'automatic' (which it nearly was) but a company official worried that he might get into trouble "with Stan Sharp of security [at Convair]" if he said publicly that the aircraft could fly at Mach 2.0. This measurement of its speed had first appeared in a NORAD news release on 19 February 1959, but some internal flak bounced around San Diego

Air refuelling greatly expanded the F-106's capabilities, although the unrefuelled combat radius with external tanks was not insignificant at 725 nm (1343 km). These 87th FIS jets were seen topping up from a KC-135 in May 1973.

Above: The 87th FIS adopted the 'Red Bulls' nickname and traditions of the 11th FIS. For a time, each aircraft even wore a bull's head marking on the nose, as seen in this 1978 view.

Left: Some FISs marked their T-33s in a 'mini' version of their F-106 scheme as seen on the 87th FIS's 'hack' in 1978.

A pair of 'Crusaders' F-106As touches down at Griffiss in an unusual pairs landing, in June 1978. Note the ADC badges on the fins. In the latter period of F-106 operations, the command badge usually replaced the unit emblem.

Accidents and incidents

With an engine that was highly reliable (after some initial problems), and a high glide ratio, the F-106 achieved one of the best safety records for a single-engined aircraft in the USAF. Despite this, of a total production of 340 airframes, 112 (including 17 F-106Bs) were crashed, destroyed or lost in ground fires during the Dart's 29-year active career, a loss rate of 33 per cent. Others were lost in mishaps during the drone programme (27) and before acceptance by ADC (two). Many F-106s were involved in lesser incidents, requiring local repair or a journey to McClellan AFB for rebuild by the Air Materiel Area/Air Logistics Center there.

Above: This spectacular mishap happened on 1 July 1972 at Hamilton AFB. The damage caused to this F-106B of the 84th FIS was repairable.

Above: This 71st FIS F-106A came to grief at King Salmon, Alaska in 1970.

Above: 58-0796 was the first F-106 to arrive for the 94th FIS – and the first to be written off, in this accident on 13 August 1961. The investigators have helpfully marked the final resting places of the landing gear components on the original photograph.

Above and right: 59-0083 of the 49th FIS exceeded g limits on a 1978 Red Flag sortie and lost the outer leading edges of both wings. It made an emergency landing at Michael Auxiliary Airfield, Utah.

Left: Another F-106 that dropped into Michael AAF during a Red Flag that year was 59-0054 of the 318th FIS, which lost its nose and radar in a collision with an A-7. It was shot down as a QF-106 by an AIM-120 in February 1996.

Above and right: These Darts were seen being railed to the Sacramento Air Logistics Center for rework following mishaps. 59-0042 of the 25th FIS (above) suffered a landing accident on 18 May 1968 and was rebuilt to eventually be shot down as a QF-106 in 1992. This F-106B of the New Jersey ANG (right), the victim of an engine fire, was rebuilt and is currently (1998) in storage at AMARC at Davis-Monthan AFB, Arizona.

Above: This trio of F-106As, two from the 48th FIS and one from the 11th FIS, was captured over Mt McKinley during a rotation of units at Elmendorf in April 1969.

Above: Carrying a pair of the original subsonic wing tanks, a 5th FIS Dart flies over Alaska during a February 1967 White Shoes deployment. The arrival of air-to-air refuelling on the F-106 fleet is thought to mark the change to College Shoes.

when the term finally appeared in the manufacturer's house paper, *Convariety*, months later. Not for a long time thereafter did anyone acknowledge that Joe Rogers's speed record flight, which preceded Forsyth's robotic excursion by some months, had attained Mach 2.36.

The USAF wanted the F-106 to be largely automatic in actual military service and even pondered an unmanned version, but the interceptor never became the remote-controlled robot that Forsyth's flight implied. From the start, the intent was that the control system would guide the interceptor to the vicinity of its target, perform the air-to-air radar search for the target, and prepare selected armament for firing, but in practice the system was used in a way that left the pilot in command. When the F-106 was launched on a GCI (ground-controlled intercept) mission, a ground operator could use the SAGE system's datalink to the interceptor's MA-1 system to effect control movements on the aircraft, but the system was more routinely used simply to pass information to the pilot – with the datalink substituting for voice instructions from the ground operator.

SAGE ground control

Most noteworthy is the fact that the MA-1 included the first digital computer ever installed on an aircraft, and that the computer (and hence the aircraft) could be pre-programmed with information about the flight plan, conditions, weather and geography.

A ground crew member regarded the SAGE system and the MA-1 this way: "The SAGE system was supposed to be able to control the vectoring of the aircraft from ground stations on intercept mission of enemy aircraft formations. The system would receive controlling signals from the ground and these were coupled to the autopilot's analog computer system. The autopilot even then was capable of completely automatic interception in two modes of operation. These were Lead Collision (any attack from the front that allowed the autopilot to manoeuvre from the front of the enemy aircraft) and Auto Pursuit (any attack from the rear that allowed the autopilot to manoeuvre from the rear half of the enemy aircraft). With the autopilot engaged and attack mode selected, the weapons control

White Shoes

Perceived inadequacies of the F-102 then on Arctic duty led to the deployment of F-106s to Alaska under the name White Shoes in July 1963 when nine F-106As from McChord AFB, Washington – five from the 318th FIS and four from the 498th FIS – were sent to Elmendorf AFB. The first intercept of probing Soviet bombers took place on 8 September 1963 when two F-106s were scrambled from Galena AFS and intercepted two Tu-16 'Badgers' over the Bering Sea. There were 35 White Shoes (later College Shoes) deployments, the last in October 1970.

Above: A 94th FIS F-106A flies with an F-102A of the 317th FIS during a White Shoes rotation. The deployments to Alaska provided the spur for fitting the 'Six' with air-refuelling gear, which was to prove essential during the

system – which included the autopilot, navigation and radar systems working together – would allow the aircraft to fly in and attack. The pilot selected the weapon he wanted to use and held the trigger down; when all the parameters were met, the weapon would launch automatically.

"On the funny side, we were always getting inflight write-ups from pilots that the autopilot system would not respond with rapid enough manoeuvres or that the autopilot responded too rapidly. We could adjust the system's response sensitivity, and did, but one pilot would want the aircraft to fly one way and the next pilot would feel differently. We did, however, know when the pilot came back with a bad headache or cracked helmet from bouncing his head off the canopy. The metal strip across the top of the canopy in the [early] F-106 was constantly colliding with the pilot's helmet."

As a new aircraft in service after an ambitious and rigorous test programme, the F-106 continued to have more teething troubles than it deserved. Part of the problem was the perception gaining favour that manned aircraft were on the way out and that a piloted interceptor like the F-106 could be replaced by an unpiloted one such as the Bomarc missile. In June 1960, the Senate deleted spending on F-106s from the defence money bill for FY 1961 and approved a spending measure that replaced the F-106 with the Bomarc. The Senate action ended plans to purchase 80 Delta Darts in addition to the 340 that became

Above: The F-106s of the first White Shoes line up at Elmendorf on 15 July 1963. The 318th and 498th FISs took part, the latter unit's aircraft without tail markings.

During the Cuban missile crisis in October 1962, at least two squadrons were deployed to Florida – the 71st to Patrick and the 48th to Homestead – to provide air intercept capability, although there was little threat to the US from Cuban bombers. On 25 October, however, 11th FIS Darts, armed with live Genies, were scrambled in error from Volk Field, Michigan not knowing that SAC had quadrupled its airborne alert over the US. Thankfully, there were no 'blue on blue' incidents.

Intercepts

The F-106 had fewer encounters with Soviet bombers than did the Iceland- and Alaska-based F-102s; however, the Delta Dart's longer endurance and air-refuelling capability allowed interception at greater ranges. The ANG units based on the Atlantic coast were the busiest units, mostly shepherding 'Bears' en route to Cuba, but the first interception of an intruder made by aircraft based in the continental US (ConUS) was carried out by F-106s of the 27th FIS based at Loring, in May 1969.

Above: The F-106 of Captain Bill Thomas of the 87th FIS, on deployment to Iceland in April 1978, formates with a Soviet navy Tu-142 'Bear-F Mod 1' long-range ASW and maritime patrol aircraft.

Above right: A Tu-95RT 'Bear-D' maritime patrol and Elint aircraft is escorted away from US airspace by a 119th FIS, New Jersey ANG Dart.

Right: Six 'Bear' intercepts are recorded on the side of this New Jersey ANG Dart.

the final production total. A newspaper report noted that, "recent Bomarc tests have proven the missile's ability to halt supersonic missiles more than 120 miles [193 km] away and a fighter plane 100 miles [161 km] away." This was an exaggeration, and the F-106, flown by real men, was to be around long after the Boeing-built Bomarc (designated F-99A until 15 August 1955, IM-99A until 1 October 1962, and CIM-10A thereafter) was gone from the inventory.

Matador 'kill'

The F-106 Delta Dart scored an aerial victory of sorts on 14 May 1960 when a TM-61 Matador surface-to-surface missile got away and had to be shot down during an Armed Forces Day air show at Holloman AFB. After an F-100 Super Sabre chase plane was unable to keep up with the Matador when it went wild, the Holloman test centre diverted an F-106A (57-0233) that had just taken off on a routine test flight, piloted by Major J. D. Fowler. The subsonic missile was at 27,000 ft (8230 m) and was 45 miles (72 km) in front of him when Fowler climbed to 32,000 ft (9753 m) and made a rear-end pursuit at Mach 1.5. Over an isolated area near Holloman, Fowler fired two GAR-3A Super Falcons, one an inert training round and the other a live missile without fuse. The Matador was struck solidly in the engine and spun to earth.

In September 1960, the USAF began Project Wild Goose, a modification programme aimed at standardising the fleet. This series of internal changes to most F-106s was completed a year later, on 18 September 1961. During this period, a separate programme to improve the fleet, Project Broad Jump, removed each F-106 from service for about 60 days for internal improvements. Yet another retrofit/modification programme, Project Dart Board, ended in April 1962.

Although the closest the F-106 got to a genuine 'kill' was the destruction of a wayward Matador missile launched at an air show, the Delta Dart proved its ability to intercept supersonic missiles, as evidenced by the Bomarc 'kill' marked on this 4750th TS aircraft from Tyndall. Ironically, the missile that 'replaced' manned fighters such as the CF-105 Arrow ended its days as a target to be shot down by manned fighters. Another F-106/Bomarc shoot-down is known to have occurred in March 1967.

A historic benchmark was reached on 20 July 1961 when Convair delivered the 277th and last F-106A (59-0148) to ADC. The production run also included 63 F-106B two-seaters, for a total of 340 aircraft. The final example was accepted in a ceremony at San Diego by Lieutenant General Robert M. Lee, commander of ADC. (The final Delta Dart, 59-0148, put in only eight years of service when, while flying with the 318th FIS, it was lost in a mishap on 22 April 1969.) Average cost of a Delta Dart was about $2 million (then equivalent to about £500,000). This was the last military aircraft manufactured in San Diego by Convair, a firm that was even then making an ill-fated venture into the commercial jetliner market. The company had been a bulwark in San Diego and would continue missile work for another decade, but by the 1970s it would be gone – part of history, like so many in what had once been a great and vast industry.

Grounding

Despite the Delta Dart's successes, on 26 September 1961 ADC had to announce that the F-106 – still officially the world's fastest aircraft – was grounded. Repairs to the fuel system were needed, though the details are no longer apparent. The command had to take this embarrassing measure after two crashes, one of which killed a pilot at Geiger AFB. ADC, which at the time had 12 F-106 squadrons, later amended the order so that Delta Darts on alert were not affected but those used for training and transition flying were kept on the ground. It could not have happened at a worse time. The F-106 returned to normal flying after minor changes (the much-needed change to its flawed ejection seat would come later) and President Kennedy's newly-appointed Defense Secretary, Robert S. McNamara, spoke of reopening the production line (not for the 80 aircraft once contemplated for FY 1961, but for 36), but neither step could breathe new life into the Delta Dart and no further aircraft were built.

The grounding of the Delta Dart was still in effect on 23 October 1961, when the Pentagon launched an air-to-air competition – Project High Speed – between the Air Force's F-106A Delta Dart and the Navy's F4H-1 Phantom (soon to be redesignated F-4B). The test programme at Langley AFB and NAS Oceana, both in Virginia, was intended to evaluate the capabilities of the aircraft to perform similar missions. ADC had heard such glowing reports about the F4H that it asked for a comparative evaluation of the F-106 and F4H in the air defence mission. Even though reopening the F-106 production line was an on-again, off-again proposition (which ultimately stayed off), the USAF's position was that it needed 200 more interceptors. ADC was extremely interested in the new McDonnell fighter.

The test consisted of 153 sorties (77 by each aircraft, with one 'abort'), flown from 500 ft (152 m) to 62,000 ft (18897 m), during which 349 valid interceptions were completed. Due to the unavailability of a B-58 Hustler to stand in as a high-speed target, three planned intercept missions were not attempted. The Phantom's APQ-72

Genie rocket

The primary weapon of the F-106 as designed was the Douglas AIR-2A Genie. AIR stood for Air Intercept Rocket and the Genie was technically unguided, although the MA-1 system would track the target, arm and fire the missile, pull the aircraft into a turn away from the blast zone, and detonate the warhead at a predetermined point. Maximum flight duration was 12 seconds, and range was approximately 10 km (6.2 miles). The Genie had been developed under a project codenamed Ding Dong (later High Card), begun in 1955, with the first (inert warhead) firing taking place in July 1959. After launch, preferably at a formation of enemy bombers, the Genie's fintips flicked out for stability and to correct gravity drop, and the 36,600-lb (162.78-kN) Thiokol TU-289 solid-propellant motor kicked in and accelerated the missile to Mach 3. The lethal blast radius of the 1.5-kT warhead was estimated at 1,000 ft (305 m), which theoretically might have allowed the target(s) to evade, but it was calculated that electromagnetic pulse (EMP) from the detonation would knock out the target's electronics.

radar demonstrated better reliability and maintainability, plus longer detection and lock-on ranges. Of these considerations, reliability was especially significant because the MA-1 system aboard the F-106 was said to have repeated technical glitches. By the end of December 1961, the USAF announced that the F4H/F-110 would be procured for Tactical Air Command. ADC would get no new interceptors.

One-sided competition

The conventional wisdom that the F4H won easily in this head-on contest with the F-106 did not appeal to Convair representatives, who had numerous complaints. "First," they concluded, "the F-4H [sic] system is about two years newer than the F-106. It has two men, a larger radar antenna, and a significant improvement in pilot display and radar lock-on capability. The armament launch characteristics are more versatile than the Falcon or the MB-1. This versatility promises better scoring in exercises, even though an actual firing might prove otherwise." (No missiles were launched in the competition.) But the real problem, complained Convair, was that the Air Force's F-106 pilots were asleep at the switch.

"The very best Navy squadron was paired against the worst or one of the worst F-106 squadrons. The Navy personnel had determination and enthusiasm as well as forced determination, i.e., 'beat the F-106s or out you go.' In contrast, there was an atmosphere of lethargy [among the Air Force participants]. No-one seemed to know how to get out of the slump they were in." Convair also complained that USAF maintainers were not adequately prepped to keep the equipment 'finely tuned'.

No detailed report comparing the two fighters has ever surfaced. Although the F4H clearly had superior radar and some other advantages, it appears that, in many sorties, F-106 pilots 'shot down' their Phantom adversaries. Contrary to myth, the men developing the F-106 knew from the beginning that it had enormous potential in the air-to-air, fighter-versus-fighter role. For this very reason, the 'Six' would later be considered for possible use in Vietnam and would appear in crisis-ridden Korea.

When the duel between the two fighters ended on 17 November 1961, the Phantom emerged with a technical edge – but, in many battles, the Delta Dart had roundly defeated the F-4.

In later years, an F-106 pilot looked at the comparison between Delta Dart and Phantom this way: "The F-4 had a longer range missile in the AIM-7 Sparrow but we [F-106 pilots] kicked F-4 butts each and every day in the visual arena. We owned the vertical on him, we got our energy back much, much quicker, had as good or better sustained turn most altitudes, and our instantaneous was also as good. He could never match our zoom when we hit the fight with any sort of knots. Our missiles had logic the early Sparrow AIM-7s were missing. In particular, the Falcon loved the beam intercept (early AIM-7 hated beam intercepts) and the Falcon loved ECM while the early AIM-7 hated ECM."

An important public appearance by the USAF's newest

Above: Although 'special weapons' were not made as accessible to ANG personnel as to regular units, the Guard F-106 squadrons trained with the Genie until it was withdrawn from service in the mid-1980s. Here an inert round is launched from a Montana ANG F-106.

Left: The Genie dropped from the rear of the F-106's missile bay, as seen on this 5th FIS aircraft. A training round with a spotting charge was a 'Ting-a-Ling'.

Below: An F-106 pilot of the 95th FIS in Korea sports the type of flying equipment most commonly used in the later years of the Dart. Pressure suits were worn more often in the early days on flights planned for 55,000 ft (16764 m) and higher. For normal flights, home-based ADC crews normally wore high-conspicuity orange flight suits and standard helmets.

A delta of Delta Darts of the 5th FIS is led by the squadron commander in his specially marked jet. The colourful markings of the F-106 were, for a short while, carried on by the F-15s which replaced them in the fighter interceptor squadrons, but it seems that the days of instantly-identifiable, brightly-marked fighter squadrons are now gone forever.

Above and above right: In April 1978, eight F-106As of the 87th FIS went to Keflavik NS, Iceland to supplement the 57th FIS, then in the process of converting from F-4Cs to F-4Es. At this time there was also increased Soviet activity around the Kola Peninsula, and ADC sent the 87th to cover the shortfall in capability. The 87th recorded three intercepts of Soviet aircraft during its Icelandic sojourn.

interceptor occurred in May 1963 when an F-106A (59-0136) of the 48th FIS (Langley AFB) appeared at the 25th Paris air show at Le Bourget.

The F-106 Delta Dart became a defender of the ADIZ (Air Defense Identification Zones) surrounding Alaska from 1963. What became known as Project White Shoes (later, College Shoes) began amid a perception of failure. On 15 March 1963, a Soviet reconnaissance bomber overflew Nunivak Island and the west coast of Alaska. A pair of F-102A Delta Daggers of the 317th FIS at Elmendorf AFB was scrambled from the alert facility at King Salmon airfield but had to be recalled when only 20 miles (36 km) from their target because of low fuel. This failure to make contact led to a furious debate in which ADC officers demanded longer-legged F-4C Phantom IIs for their squadrons. They had an excellent precedent: years earlier, while war was raging in Korea, ADC had enjoyed priority for delivery of new fighters even over squadrons committed to battle during the Korean War. This time, however, ADC was told that the war in Southeast Asia would have priority for any assignments of the F-4C.

Rotations through Alaska

ADC then decided to keep up rotational deployments of eight F-106s at a time from continental US squadrons to assist in the air defence of Alaska. These deployments – White Shoes – began on 15 July 1963 with the arrival of nine F-106As from McChord AF, five from the 318th FIS and four from the 498th FIS. The 498th FIS then had no unit markings applied, while the 318th FIS aircraft had a North Star motif.

Two F-106s were scrambled from another alert facility at Galena, Alaska on 8 September 1963 and intercepted two Tupolev Tu-16 'Badgers' over the Bering Sea off the northwest coast of Alaska. The White Shoes operation in Alaska also involved the permanent stationing of a support element of about 80 airmen. One of these veterans remembers that reconnaissance aircraft and bombers were not alone in drawing F-106 attention: "MiG-21s from Siberia routinely crossed into the ADIZ to test our defences and we often went after them." The long White Shoes/College Shoes commitment finally ended on 2 October 1970 after seven years and 35 deployments, when the 84th FIS returned to Hamilton AFB, California. Thereafter, F-106s travelled to Alaska only for brief appearances in summer and winter exercises.

Above: A Standard AAM is seen on the starboard fuel tank pylon of a 4750th Test Squadron F-106A. It is not clear if live firing tests were conducted with the Delta Dart or if actual XAIM-97 rounds were ever carried.

Right: The 4750th was the 'Skunk Works' of the ADWC, testing various air-to-air weapons concepts. This F-106 has a camera in the cannon housing.

Ejection seat revisited

The efforts to put the right ejection seat in the F-106 neared completion in 1965, as the USAF began to retrofit its Delta Dagger fleet with the Weber F-106 seat. This upward ejection seat used an M3A1 catapult initiator to send pilot, seat and BA-18 parachute into space. The Weber seat was frequently referred to as a 'zero-zero' seat, meaning that if necessary the pilot could safely eject while standing still on the ground. Actual tests showed it effective in about 95 per cent of realistic bailout scenarios.

Weber Aircraft carried out the only live 'zero-zero' test ever conducted by an American company in October 1965, using an F-106 seat occupied by Jim Hall, an experienced fighter pilot and parachutist. Weber delivered the first squadron's seats in only 45 days, and once they were installed in F-106s, the Convair 'B seat' was relegated to the scrap pile – where it belonged.

Goose Bay, Labrador was home to a fighter-interceptor commitment deemed vital to the defence of North America. Beginning in late 1966, ADC planned for the inactivation (in late 1967) of the F-102A-equipped 59th FIS at 'Goose' to fill an anticipated gap in the air defence of the northeastern United States. Soviet harassment of Labrador and Greenland airspace was on the increase. Interceptors would still need to fly from Goose Bay. The College Goose project called for six F-106As at a time to rotate through the base in the same way that other 'Sixes' had been operating in Alaska. The 27th FIS at Loring AFB, Maine, being the closest F-106 unit, drew the initial deployment.

By April 1967, ADC was re-evaluating the College Goose situation. For several reasons, availability of F-106s

Satellite killer

In October 1971 the Space and Missile Systems Office of AFSC informed USAF HQ that Project Spike, based on an AGM-78 Standard anti-radar missile, was a feasible anti-satellite (ASAT) weapon. Although this system was not adopted, the USAF and General Dynamics' Electro Dynamic Division developed an experimental missile under the codename Seekbat. The missile, also designated XAIM-97A, was intended for carriage by the F-4 – and possibly the F-106 – and was basically an AGM-78-6 with an IR seeker and a larger motor. Israel and Japan were particularly worried about the threat from the high-flying Mach-3 MiG-25 'Foxbat' interceptor, and the proposed AIM-97 would have been self-guiding to 80,000 ft (24384 m), the MiG-25's supposed operating altitude. The Standard airframe, already cleared for the F-4, was trialled on a Tyndall F-106. Reportedly, six Seekbats were available by the time of the 1973 Yom Kippur War, but there was no time to modify more Standards before it ended. Like the Navy's similar missile, the Brazo, Seekbat did not enter service,

William Tell

The biennial William Tell (WT) weapons meet was first held at Yuma, Arizona in 1954 for units of Air Defense Command concerned with defence of the contiguous US. In 1958, William Tell moved to Tyndall, Florida and in time broadened its scope to include air defence units of other commands and from Canada, as well as the Air National Guard. The competition element involved the various units flying a range of intercept profiles against other manned aircraft and live-firing against both BQM-type drones and 'droned' aircraft such as the QF-100 and QF-102. The competition was fierce in the air and on the ground, and traditions arose of decorating the aircraft – and everything else that did or did not move – with squadron motifs and other imagery. The F-106 first participated in WT '61 and for the final time in 1984.

Above: Some of the humour displayed by William Tell participants was ever so slightly obscure to the outsider. These exhaust covers on Montana ANG F-106s in 1978 depicted a 'Swedish farmer' and a 'Swedish flagpole'.

Below: The 49th FIS brought this decorated T-33A to William Tell in 1974. Behind it can be seen the 'hacks' of other ADC squadrons.

Above: An F-106 of the 49th FIS is moved by an engineer into its parking spot alongside 'Sixes' of the 318th FIS and Canadian Armed Forces CF-101s at WT '82. The 'Green Eagles' pilots (left) had their own special ground transport in 1978.

Above: A 190th FIS, Idaho ANG F-102A flies with a 318th FIS F-106A and a CAF CF-101B over Tyndall circa 1968-74. The two US units were responsible for the defence of northwest North America, together with Canadian Voodoos.

Below: Various buildings used by the visiting squadrons received adornment, as well as aircraft and support equipment. 'Taz' dates from WT '78, and 'Florida's 'Fang' from 1976.

The Florida ANG provided the 'target' aircraft for unarmed interception profiles in 1986. White, orange and yellow trim was applied to some of the 194th FIS aircraft.

was expected to be at a premium. ADC recommended that F-101B/F Voodoos be substituted for the F-106s, which would give the Voodoo squadrons mobility training they would not normally get. So, on 1 July 1967, when the 27th FIS F-106s rotated home, six F-101s from two squadrons took over the Goose Bay job.

The College Goose effort was eventually scrapped altogether but Soviet bomber flights persisted in 1967-68 and activity was heavy along the Greenland-Iceland-UK (GIUK) line. A new plan, College Shaft, was implemented on 20 November 1969. Again, the Loring-based 27th FIS was selected for the job. On 13 May 1969, two F-106s were scrambled from Loring. Two hours and 33 minutes later, after landing and servicing at Goose Bay, they intercepted Russian bombers at a point 150 miles (241 km) from North America and 750 miles (1207 km) from Loring. This was the first time interceptors based in the continental US had intercepted Soviet aircraft. F-106s participated thereafter in College Shaft operations involving both brief appearances at Goose Bay and longer stays; they ended on 1 July 1970, after 14 deployments.

Installation of a gun on the F-106 was directly prompted

Above: A feature of ANG operations was (and is) the sharing of bases with civilian air traffic. The New Jersey ANG's 119th FIS shared Atlantic City's airport with 747s full of gamblers come to spend in the city's casinos.

Right: The Montana Guard was the first ANG unit to receive the 'Six'. It handed in its F-102s in the spring of 1972, and its F-106s 14 years later.

Far right: B-52s were a common intercept target for F-106s such as this 194th FIS, California ANG machine. Note the extended IR sensor.

The F-106 joined the Air National Guard in 1972, with the first delivery to the 186th FIS on 3 April. The aircraft were transferred from the 460th FIS, which traded up to upgraded aircraft. The 171st FIS (Michigan) and 101st (Massachusetts) also received their first Delta Darts that year. In all, six Guard units became F-106 users, the longest-lived of them being the 119th FIS from New Jersey, which flew the 'Six' from 1973 until 1988.

by Lieutenant General Arthur C. Agan, Jr, who commanded ADC from 1 August 1967 to 28 February 1970, and who felt that his command could contribute more to the ongoing war in Southeast Asia. Perhaps Agan remembered that, during the 1950-53 Korean conflict, ADC had enjoyed a high priority for receiving weapons and equipment but had contributed nothing to the fighting abroad. In any event, Agan asked for suggestions on how the F-106 could be employed for 'top cover' in Vietnam. A staffer, Lieutenant Colonel Bob Archibald, prepared a list of recommendations which included changes in training and equipment, a quick-shoot modification for the Falcon missiles, a clear-view canopy, tactical camouflage, and – above all – a gun. Air Force Systems Command, which was responsible for testing, looked at some of Archibald's suggestions and vetoed them, saying the F-106 had no mission with which the proposals could correspond.

Project Six Shooter

1967 was the year when North Vietnamese MiG-21s were scoring heavily against USAF F-4C Phantoms which had been built without guns; the MiGs scored a little-mentioned kill ratio of about 3:1 against the Americans. Archibald and others wanted a gun on the F-106 so badly that they bypassed AFSC and borrowed a pair of 20-mm gun pods from the Navy. Somehow, $1.7 million was scraped up to test a gun in what became known as Project Six Shooter, directed by Brigadier General James D. Price with help from Major George R. Hennigan. Price could hardly have been a better choice: as a wing commander, he had watched men die in Korea in June and July 1950 because they lacked weapons that were routinely going to ADC.

The gun was primarily intended to provide extra firepower and a close-in kill potential for aircraft with a non-nuclear mission (the 'Six' would be able to carry gun or Genie, but not both), but interest in a gun also reflected the growing consensus that the F-106 might be useful in fighter-versus-fighter combat. The gun was also meant to augment the F-106's capability at low altitude, where the threat from bombers seemed increasingly concentrated. Convair set forth to re-equip the F-106 with a gun, an optical gunsight and a clear-view canopy in a programme that became known as Project Six Shooter. The arrangement came in the form of a 'kit' that could be installed by maintenance men at an operational airfield, but was not easily interchangeable: once the gun was installed, it took an experienced ground crew eight hours to remove it and restore Genie capability.

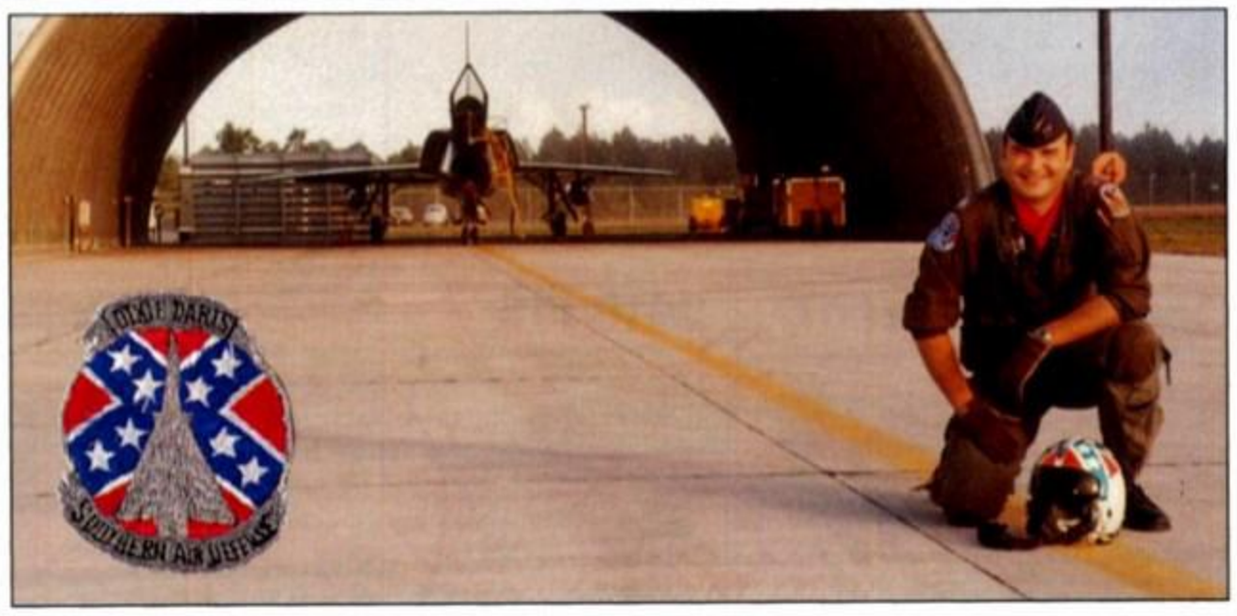
The weapon was a General Electric M61A1 20-mm Vulcan Gatling cannon with 650 rounds of standard electrically-primed HEI (high-explosive incendiary) or ball ammunition. The gun was to be located in an armament bay created by removing the Genie rocket. The gun came with a rounds-limit switch that gave the pilot the option of firing the gun until ammunition was depleted or using a counter to select the number of rounds to be fired. The gun was safetied on the ground: after engine start, the crew chief was to signal the pilot to raise his hands to a visible position, then remove gun safety devices and arm the gun for flight.

The Project Six Shooter gun installation was tried first on F-106A 58-0795 assigned to the Six Shooter programme on 10 February 1969, and subsequently on F-106A 59-0092 assigned on 29 March 1972. At Tyndall, an 'in-house' prototype gunsight was developed with a 'snap shoot' capability.

During contractor tests prior to releasing the gun-armed

Below: The 101st FIS, Massachusetts ANG (The 'Irish Guard') at Otis AFB (later ANGB) adopted 'Cape Cod' titles for its F-106s to reflect its location. The 101st received Darts in 1972 after a only a year on F-100s.

Below right: A peculiarity of Montana ANG F-106s was their blue cockpit interior, reportedly based on that of the MiG-25, part of which can be seen in this view of aircraft at William Tell.



Flying the F-106

Lieutenant Colonel Mike 'Buddha' Nelson, seen here at Tyndall AFB in 1975, rates the F-106 as his favourite of many fighter types flown. The 'alert' commitment at Tyndall at this time was filled by the Southern Air Defense Detachment (SADD), the 'Dixie Darts' employing ADWC aircraft and pilots attached to the Interceptor Weapons School. From 1976, the duty passed to the Florida ANG at Jacksonville.

"To quote Hemingway, 'A man has one virginity to lose in fighters, and if it's a lovely airplane, there will his heart remain forever.'

"I have flown several fighters and fighter trainers – T-38, T-33, A-37, F-101F, F-106A/B, F-4C/D/E (slatted), F-5E/F, F-15B and F-16D, and my heart lies forever with the 'Six'. Of all the fighters, I found the F-106 the lightest and most responsive on the stick. When flown by a skilled pilot, it could be safely flown from the deck to 80,000 ft, from (in some circumstances) zero airspeed to Mach 2. One could fill a small book on the fine points of manoeuvring the airplane, the techniques that the 'book' doesn't tell you (the difference between case 14 and case 29 wings, etc.).

"It was an honest bird. Without visual or audio prompts/cues, the 'Six' provided outstanding feedback to the pilot. Following the 'pebbles-rocks-boulders-sudden quiet' progression of buffet, the pilot could 'feel' the angle-of-attack. This was important, as differential elevon deflection caused adverse yaw, away from the direction of the turn. This, in turn, could lead to violent departures from controlled flight at the stall, and, if proper recovery procedures were not initiated, to a multi-axis or a flat spin. Spins, except for the dreaded flat spin, were eminently recoverable, given sufficient altitude. The airplane responded well to judicious application of forward stick (negative angle-of-attack), and could actually be flown to zero airspeed in a vertical climb, tail slide backwards, and turned with the rudder while falling backwards.

"In air-to-air combat with another fighter, the 'Six', due to its low (38 psi) combat wing loading, exhibited quick turning, quick recovery of energy, and outstanding 'nose authority'. Nose authority allowed the pilot to employ lag manoeuvres to gain position to fire the AIM-4Gs directly at the tailpipe, then pull the nose into a lead position to employ the AIM-4Fs and/or the gun. The altitude capability the 'Six' enjoyed over other period fighters meant that we could comfortably CAP at 45,000+ ft, perform a pincer front-to-stern attack with the IRST (radar in STBY) and slide in behind a flight of F-4s, etc. without notice.

"The responsiveness of the airplane, its capabilities of turn, speed and altitude, and its honesty in feedback, were the seeds of a life-long love affair. The F-106 never surprised me, everything it ever did was what was expected, given the conditions of flight. I never fully 'departed' the airplane, as it always responded immediately to recovery controls. In my capacity of weapons/flight instructor, I taught many fledgling 'Six' pilots to trust the airplane at low airspeeds and in high angle-of-attack manoeuvring. There have been many comments about the F-106 being a forgiving airplane – I disagree. Many a ham-handed aviator has come to grief with the airplane. However, in the hands of a skilled pilot, a pilot who listened when the airplane spoke, it was a real thoroughbred and an absolute joy to fly.

"A characteristic of the delta wing was a loss of elevon effectiveness above Mach 1 due to the shift in the centre of pressure on the wing. This shift was the reason for the installation of the 't-tanks' (transfer tanks) which shifted the centre of gravity in supersonic flight. Early aircraft had to keep trimming the stick aft as Mach increased, so that at Mach 2 the stick was virtually full aft. The 't-tanks' gave full range of stick movement, but did not make the elevons more effective.

"The F-106, like the F-4, fought best at around 0.92 Mach. Turns in the transonic/supersonic regime were handled better by the F-4, but pilots were not trained to fight supersonic in dogfights. Further, each of the airplanes had 'transonic tuck' problems. The F-106 suffered abrupt increase of elevon effectiveness coming subsonic, and the F-4 suffered a similar problem due to increased stabilator effectiveness, particularly in the birds with slotted stabilators.

"On the subject of cockpits: the early F-106s had the F-102 scope and required the use of a light shield or 'muff' for daytime use; the green multi-mode storage tube (MMST) came later, and eliminated the need for the 'muff'. (As an aside, the F-106 flight simulators retained the F-102-type scope at the instructor's console, while the simulator cockpit itself had an MMST.) As regards automatic flight, the autopilot could be coupled to the automatic navigation system 'Auto Nav' which used pre-set TACANs, the way points and profiles stored in the computer or the ILS localiser and glidepath, or it could be coupled to the SAGE, Back Up Interceptor Control (BUIC), or AWACS datalink. The datalink used was tactical time-division datalink, or TDDL. We used AWACS TDDL until the end. However, the autopilot did not have any throttle control. Regardless of the automatic flight mode, the pilot had to provide the throttle inputs.

"In the discussions of F-106 overseas deployments, there were several 'demonstration' deployments in the 1970s, to the Canal Zone and to Germany, for example. The 'Six' was favoured by the State Department because (1) it had no advertised air-to-ground capability, (2) no-one could tell whether or not it was loaded, and (3) [it introduced] the shadow of nuclear capability. College Tap was very real. As an instructor at Tyndall, I was expected to maintain full combat status and proficiency, even so far as to have the ADCOM IG give us a full-scale operational readiness inspection (ORI) to prove the point.

"I think the thing that does not come across is how advanced the F-106 was, even at the end of its life. The radar power and reliability problems had been long since conquered; contact ranges were up 100 per cent from where they were when I started flying it. The IRST was continually upgraded with new electronically cooled sensors and computer programmes (IR Prop), boresight lock-on capabilities, and angle-ranging. The Snapshoot gun systems was arguably the best air-to-air sight going. New MA-1 capabilities included Target Velocity Vector (TVV) which allowed us to sample lock a target to get his speed altitude and heading, break lock, and use the MA-1's dead-reckoning to track the target on the radar screen, the TSD, and the HSI. We were the bane of the early F-15s as we were better versed in radar tactics and could get in on them using the foibles of their system against them. We owned the low-level arena, as the F-15s needed drop tanks to fight for any time at all, and we had the only supersonic tanks (i.e., we could go faster and farther), and we could run down and shoot F-111s, F-105Gs – you name it.

"Our biggest foible was the AIM-4. The contact fuse and the lack of a blast-fragmentation warhead (ours was blast-overpressure) left us out of the modern arena, when it was decided by General Creech not to rearm the 'Six'. (Incidentally, the AIM-4G had essentially the same all-aspect seeker as the AIM-9L, and as studies of air combat in SEA were to reveal, the AIM-4D with the same basic seeker, when fired within parameters, was the most lethal of the air-to-air missiles carried by US forces.)"

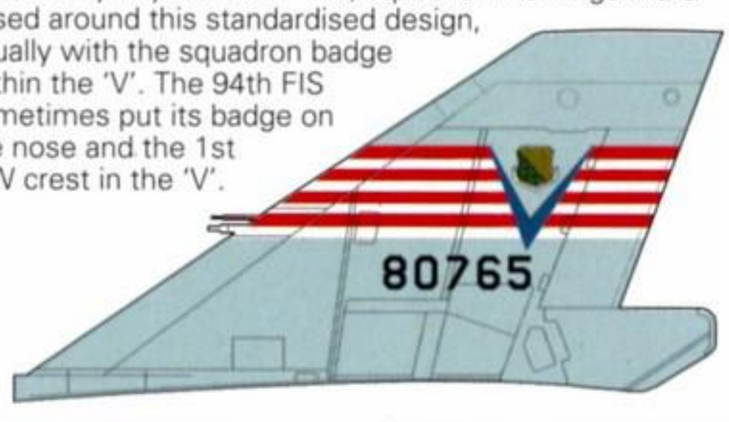
Lieutenant Colonel Michael K. ('Buddha') Nelson

Like all good interceptors, the F-106 had a phenomenal climb rate – 41,200 ft (12558 m) per minute at sea level. This was eclipsed by its British contemporary, the Lightning, at 50,000 ft (15240 m) per minute. With its extremely low wing-loading, however, the 'Six' had the edge in air combat manoeuvring. Comparative production was 339 Lightnings and 340 Delta Darts, with service careers spanning 1960-88 and 1959-88, respectively.

F-106 Colours

1st Fighter Interceptor Wing

In the early days of the F-106, squadron markings were based around this standardised design, usually with the squadron badge within the 'V'. The 94th FIS sometimes put its badge on the nose and the 1st FIW crest in the 'V'.

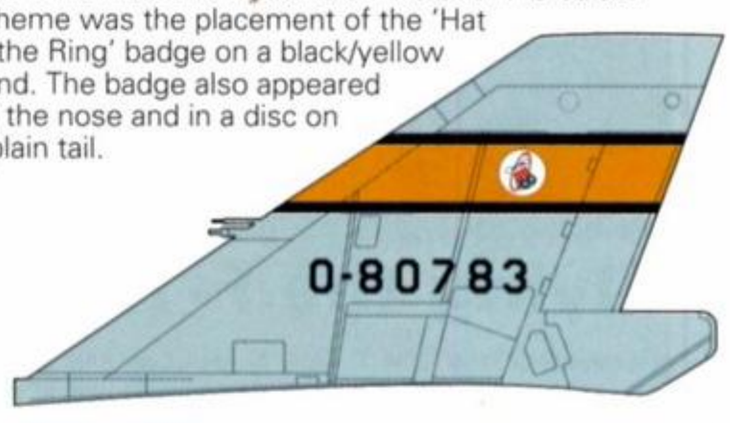


49th FIS

The 'Crusaders' adopted a stylised green-and-white eagle marking. In common with most squadrons in the ADTAC era, the TAC crest replaced the unit badge on the fin from the late 1970s.

94th FIS

One of numerous variations on the 94th FIS colour scheme was the placement of the 'Hat in the Ring' badge on a black/yellow band. The badge also appeared on the nose and in a disc on a plain tail.



2nd FIS

The 'Horney Horses' unicorn badge was carried in this black-edged yellow band. The 94th FIS used this style until it transferred its aircraft to the 2nd.

The 49th FIS 1776-1976 commemorative special scheme included the 13-star colonial flag and the 'crusader' squadron badge on the fin.

95th FIS

The 95th FIS tail marking was originally a large disc containing the 'Mr Bones' squadron badge. Later this was incorporated in a diamond on a chordways band which was either medium or light blue.

5th FIS

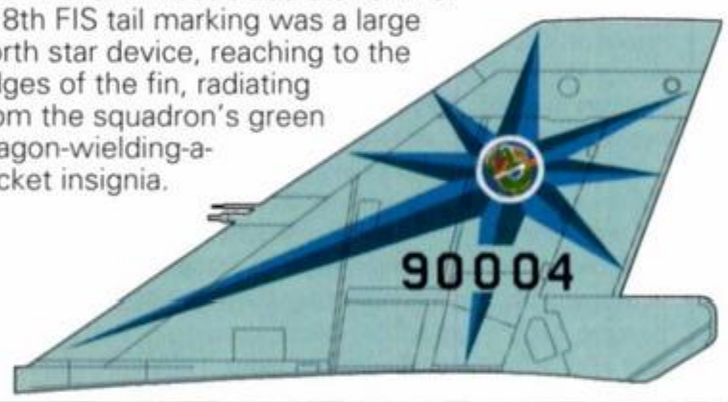
The later markings of the 5th FIS featured a stylised lightning bolt with five stars. The 'Spittin' Kitten' faced to the rear.

71st FIS

The 71st FIS's badge of a diving winged gauntlet was worn on a blue chevron.

318th FIS

The final and most elaborate form of 318th FIS tail marking was a large north star device, reaching to the edges of the fin, radiating from the squadron's green dragon-wielding-a-rocket insignia.



11th FIS

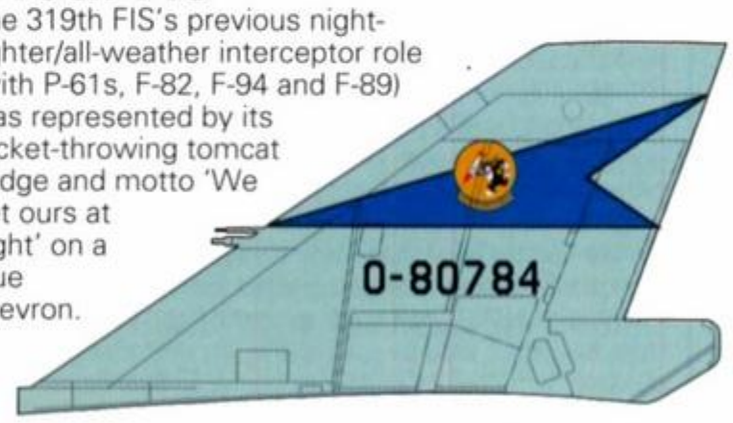
The first 'Red Bulls' placed its lightning-snorting charging bull above a red chevron. The 87th FIS later adopted the traditions and markings of the 11th, with a new design of bull.

83rd FIS

The ace of spades appeared at the points of the 83rd FIS tail chevron marking and on the badge, encircled by a golden horseshoe and pierced by a lightning bolt.

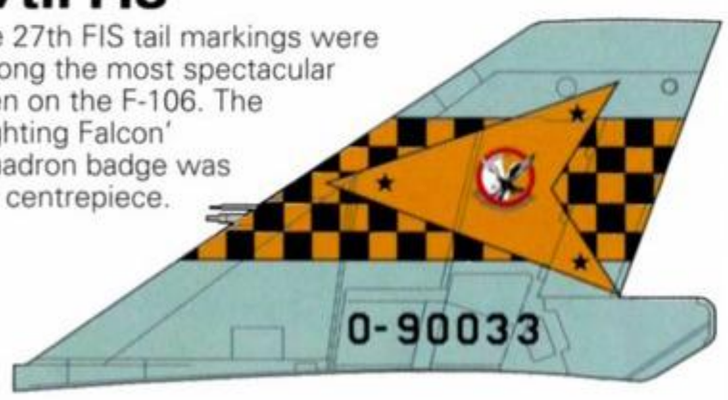
319th FIS

The 319th FIS's previous night-fighter/all-weather interceptor role (with P-61s, F-82, F-94 and F-89) was represented by its rocket-throwing tomcat badge and motto 'We get ours at night' on a blue chevron.



27th FIS

The 27th FIS tail markings were among the most spectacular seen on the F-106. The 'Fighting Falcon' squadron badge was the centrepiece.

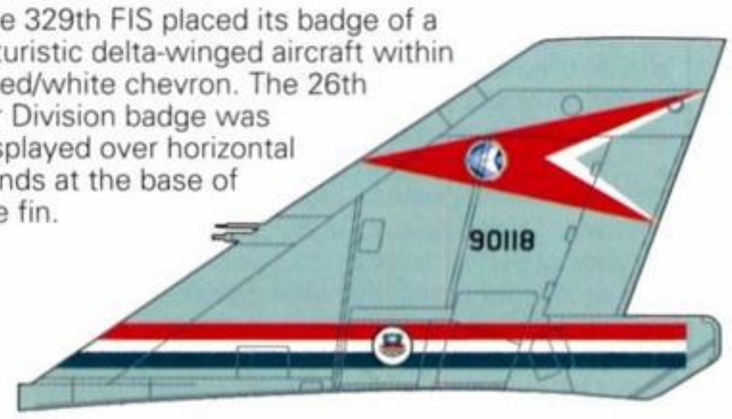


84th FIS

The 84th FIS took over the aircraft of the 498th FIS and applied its badge to the 498th's last markings. The black panther insignia later appeared on a red/white/black band.

329th FIS

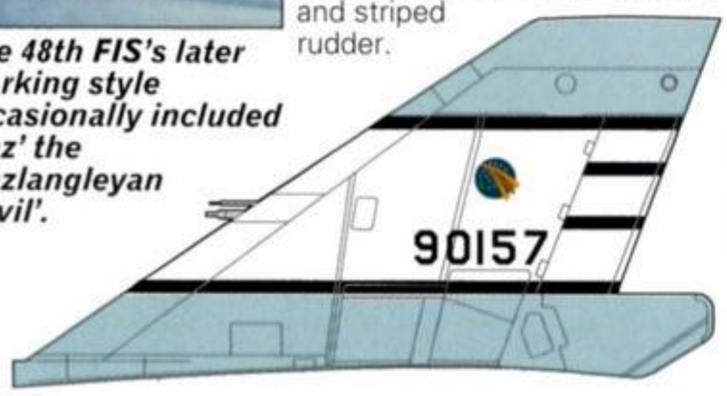
The 329th FIS placed its badge of a futuristic delta-winged aircraft within a red/white chevron. The 26th Air Division badge was displayed over horizontal bands at the base of the fin.



48th FIS

A broad white fin band with black rudder stripe was used by the 48th for some time, replacing a solo badge in various sizes. The last style used was a blue/white chevron and striped rudder.

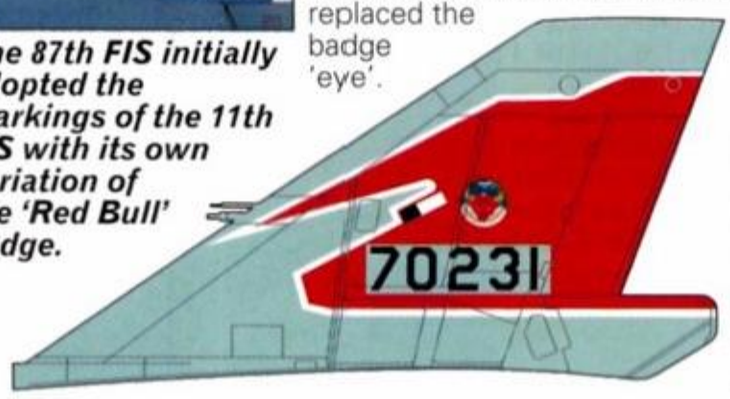
The 48th FIS's later marking style occasionally included 'Taz' the 'Tazlangleyan Devil'.



87th FIS

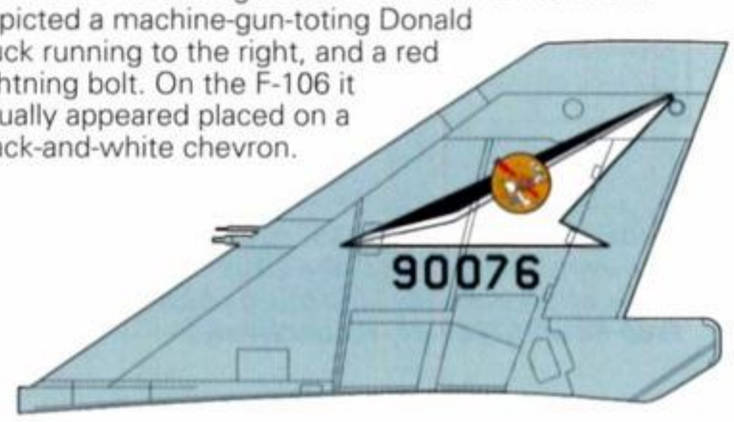
The 87th's stylised bull's head fin marking was probably the most original design used on the F-106. There were several variations in the shape of the head, and later the TAC insignia replaced the badge 'eye'.

The 87th FIS initially adopted the markings of the 11th FIS with its own variation of the 'Red Bull' badge.



438th FIS

The 438th FIS's badge dated from World War II and depicted a machine-gun-toting Donald Duck running to the right, and a red lightning bolt. On the F-106 it usually appeared placed on a black-and-white chevron.

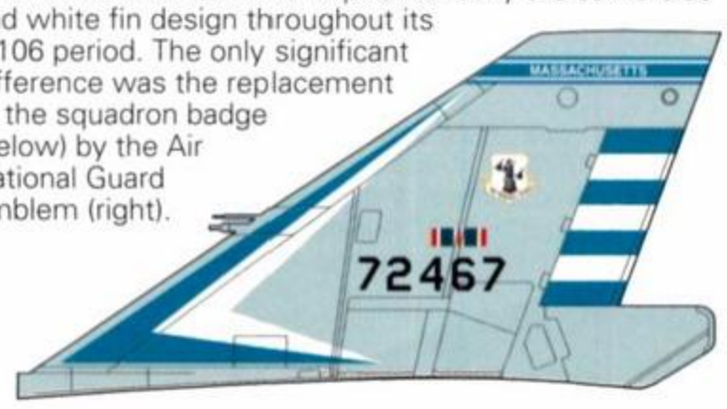


456th FIS

The 456th FIS placed its badge of a ferocious (six-legged) octopus on a yellow tail with black trim. The 456th was redesignated the 437th FIS, but it is not thought that the unit ever applied its badge to the base markings that it inherited.

101st FIS, Mass. ANG

The Massachusetts ANG kept essentially the same blue and white fin design throughout its F-106 period. The only significant difference was the replacement of the squadron badge (below) by the Air National Guard emblem (right).



186th FIS, Montana ANG

Like most of the ANG F-106 units, the Montana Guard did not display its squadron badge on the aircraft. Instead, the state name and a local nickname were worn on blue bands throughout the F-106 era. The F-16s introduced in 1987 retained the 'Big Sky Country' titles.

460th FIS

The 460th FIS was a redesignation of the 437th FIS. Initially, it used the same yellow fin originated by the 456th FIS for its 'Cave Tigrim' (Beware of the Tiger) badge, but later changed to this design.

194th FIS, California ANG

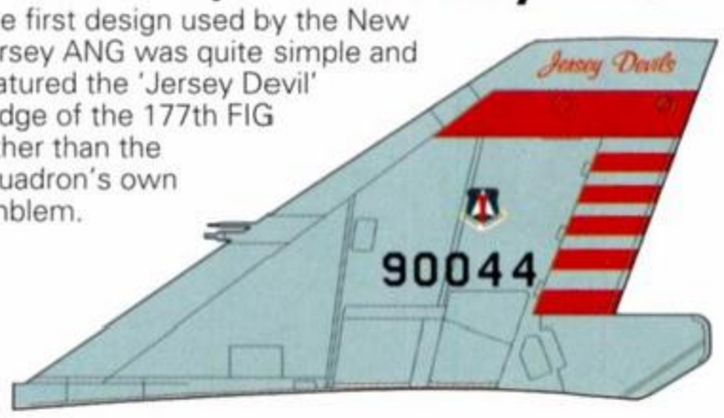
California's Guard F-106s wore an all-white tail and the bear of the California Republic state flag. This popular marking was later changed to a simple blue band with 'California' titles.

498th FIS

The 498th's 'Geiger Tiger' badge was initially displayed in a large disc on a fin with a red rudder. The design used for the longest time placed the badge in a disc with a 'swoosh' and had a giant lightning bolt across the base.

119th FIS, New Jersey ANG

The first design used by the New Jersey ANG was quite simple and featured the 'Jersey Devil' badge of the 177th FIG rather than the squadron's own emblem.

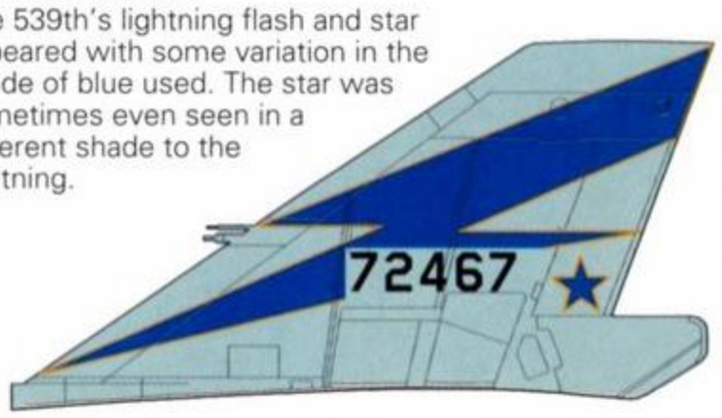


B-1B Chase

The F-106s used by the USAF's Contract Management Division on B-1B bomber acceptance test flights wore this stylised representation of their mission. Black and red versions of the design also existed.

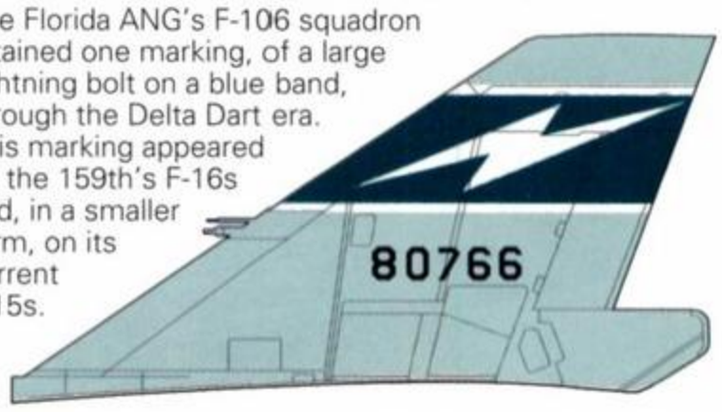
539th FIS

The 539th's lightning flash and star appeared with some variation in the shade of blue used. The star was sometimes even seen in a different shade to the lightning.



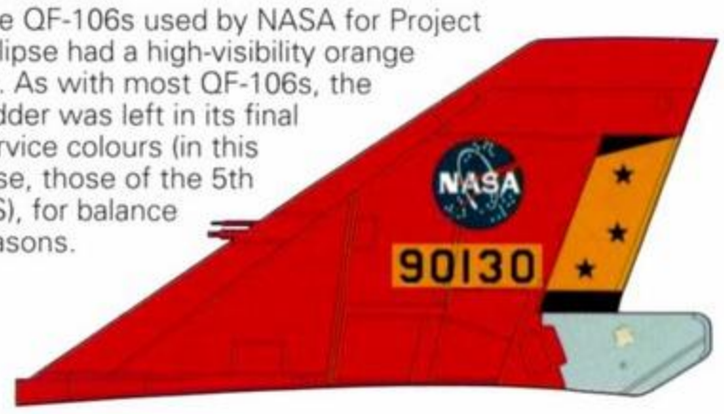
159th FIS, Florida ANG

The Florida ANG's F-106 squadron retained one marking, of a large lightning bolt on a blue band, through the Delta Dart era. This marking appeared on the 159th's F-16s and, in a smaller form, on its current F-15s.



NASA

The QF-106s used by NASA for Project Eclipse had a high-visibility orange fin. As with most QF-106s, the rudder was left in its final service colours (in this case, those of the 5th FIS), for balance reasons.



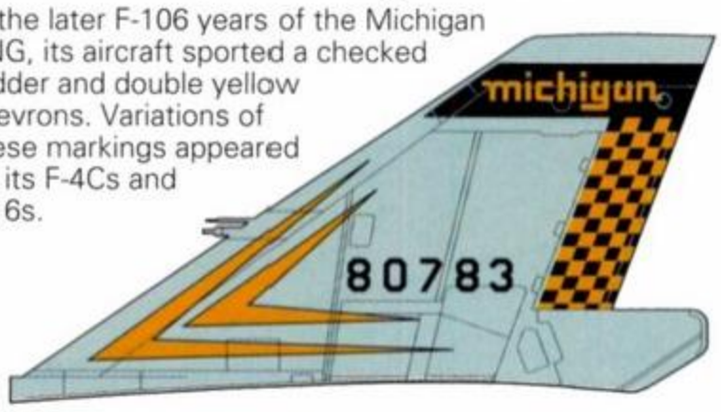
Air Defense Weapons Center

The first tail markings used on ADWC F-106s featured a large Center badge and a red/white/blue chevron at the forward end of the fin.The '0' for 'Obsolete' prefix was applied to the serials of aircraft over 10 years old.

The ADWC markings were later toned down slightly and the Tactical Air Command badge replaced the ADWC insignia. The '0' prefix was seen between 1956 and 1964, when it was removed.

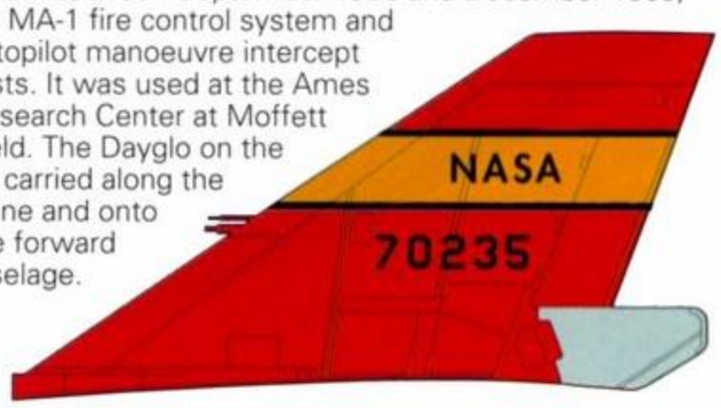
171st FIS, Michigan ANG

In the later F-106 years of the Michigan ANG, its aircraft sported a checked rudder and double yellow chevrons. Variations of these markings appeared on its F-4Cs and F-16s.

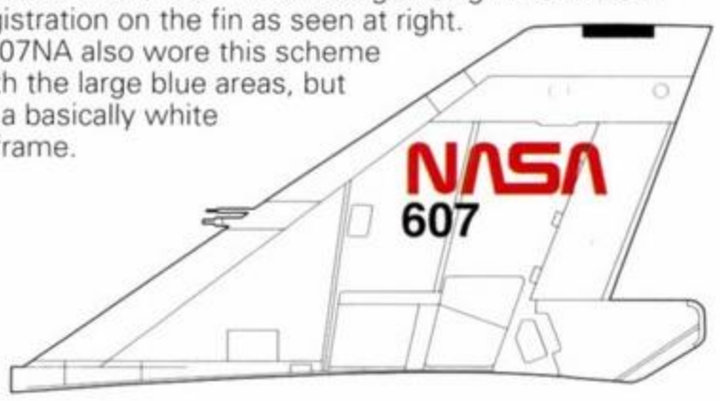


The original markings of the Michigan Air National Guard's F-106s included the 'Six Pack' nickname and the early-style circular ANG badge.

An early F-106 used by NASA, 57-0235, was bailed to NASA between September 1958 and December 1959, for MA-1 fire control system and autopilot manoeuvre intercept tests. It was used at the Ames Research Center at Moffett Field. The Dayglo on the fin carried along the spine and onto the forward fuselage.



NASA F-106B N607NA (57-2507, the first two-seater) wore a predominantly white scheme with a blue cheatline for some time. The NASA 'worm' logo replaced the circular NASA badge design and the civil registration on the fin as seen at right. N607NA also wore this scheme with the large blue areas, but on a basically white airframe.



Left and above: The basic overall colour scheme for the F-106 was FS 16473 'ADC gray'. The line-up of glossy airframes being reworked at McClellan in 1962 (left) typifies the usual appearance of this scheme, in contrast to the worn appearance of this late New Jersey ANG without unit markings (above).

Left: At least two aircraft were seen at the SAALC at Kelly Field in gloss 'Air Superiority blue' (FS 15450) as used on early F-15 Eagles.

Right: A stripped F-106B seen after rework at Sacramento.

Left: NASA 607 (57-2507) is seen in the NASA house colours still in use today.

Below: The NF-106B used for the vortex flap programme was mainly flown in bare metal. The wings were painted black to help visualise the movement in the airflow of the tufts on the wing.

Left: Storm-hunting NF-106B NASA 816 is shown during in 1982. Paint spots were applied to mark lightning strike points.

Right: 57-2507 of the 6511th Test Group is seen in 1969 with a Dayglo radome.

Above: The fifth F-106A assigned to the test programme (56-0455) is seen in typical period high-visibility markings while assigned to the AFFTC for Category II testing.

Right: 56-0459 was painted over-all Dayglo while with the AFFTC. This colour scheme appears to have been unique to this aircraft.

Fire-control system
Hughes's MA-1 (formerly MX-1179) Automatic Weapons Control System (AWCS), incorporating the first digital computer to be built into a fire-control system, remained at the heart of the F-106A's capability throughout its 29 years of service and was subject to over 60 different modifications and upgrades in that time (F-106Bs carried a similar AN/ASQ-25 system). A datalink with NORAD SAGE (Semi-Automatic Ground Environment) and AWACS controllers meant radio silence could be maintained during an intercept, while an autopilot allowed these controllers to 'fly' the aircraft from 'wheels up' until final approach to the target. A Tactical Situation Display (TSD) between the pilot's feet provided a moving map of the route relative to the ground, the pilot's aircraft and his target.

The various adjustments made to the MA-1 system during early production meant that successive production batches were completed to varying standards – a maintenance nightmare. In 1960/61, Project Wild Goose attempted to standardise mission-related avionics and airframes, and took a year to complete. Reliability problems plagued the MA-1 and ASQ-25 systems. Two programmes completed in 1963 attempted to rectify the situation, providing anti-chaff devices and enhancing detection and lock-on range by 30 per cent. In all, 314 F-106As and Bs received these modifications.

Armament: Hitting a flea with a sledgehammer!
The F-106 was conceived as an interceptor of Russian bombers and, as such, was origina equipped with an all-missile armament. All were carried within a fuselage weapons bay, t cutting down on drag. The primary weapon in the Delta Dart's arsenal was the McDonnel Douglas AIR-2A Genie unguided rocket, equipped with a 1.5-kT nuclear warhead. Genie h flight time of about 12 seconds and a blast radius of 1,000 ft (305 m), and was carried in t rear of the Dart's weapons bay. For the head-on engagement of Soviet bombers, a guide missile was required. To this end Hughes developed the conventional variant of their nucl AIM-26A Falcon for the F-106. Conventional AIM-4 Super Falcons equipped F-106s, a pair AIM-4Es with semi-active radar homing filling the forward half of the weapons bay (initiall and a pair of AIM-4Gs, with infra-red guidance, to the rear flanking the Genie. For many ye this configuration (known as Standard Area Intercept IV) was typical of air defence '106s, included 360-US gal (1363-litre) drop tanks.

'Missiles all' with the AIM-4
Because the aerodynamic range of the AIM-4F was greater than the range at which the seeker head radar could track a target, the IR-guided AIM-4G was the weapon of choice for high, fast targets. At high closure speeds, the MA-1 would actually present two missile-firing countdowns, the first for the -4G, and the second for the -4F. In a 'missiles all' armament selection, the -4Gs were fired first so they would not 'switch' lock-on to the radar-guided missiles. As a further precaution, the AIM-4F pair was carried in the aft bay.

AIM-4Fs and Gs were fired in 'like' pairs and ripple-fired so one would always be ahead of the other. Firing the missiles in pairs was not done primarily to increase Pk (kill probability); the pneumatic system had only enough stored high-pressure air for three cycles of the armament system – two cycles of the bay doors and missile rails, and one cycle for the AIR-2A. Therefore, there were essentially three shots: one AIR-2A, one pair of AIM-4Fs, and one pair of AIM-4Gs.

The 49th Fighter Interceptor Squadron
The 49th FIS had its origins in the 49th Pursuit Squadron (Fighter), activated on 15 January 1941 at Hamilton Field, California as part of the 14th Pursuit Group. Equipped initially with a variety of aircraft types, including Curtiss P-40s, Republic P-43s and Vultee P-66s, the 49th was engaged in air defence patrols from San Diego during the days after the attack on Pearl Harbor. By the end of the year, the unit was re-equipping with Lockheed P-38s, and was preparing to transfer to Europe with the rest of the 14th PG as part of the 12th Air Force. Redesignated the 49th Fighter Squadron in May 1942, the unit moved to England and during October undertook missions over France from its base at Atcham. The group's move to North Africa came the following month, after the Torch landings, the 49th's P-38s spending most of the next two years in Algeria. By VE-Day, the squadron was in Italy, where it was inactivated in September.

Back in the States, the 49th FS/14th FG was activated again in 1946, for a three-year stint at Dow Field, Maine, equipped with Republic P-47s and the unit's first jet aircraft, Republic F-84s. In 1949 the 49th was once again inactivated; the unit's next incarnation came in 1952. Based again at Dow Field, the unit was briefly equipped with Lockheed F-80s, but soon picked up much more capable North American F-86s for its air defence role within the 4711th Defense (later Air Defense) Wing, Air Defense Command. These it flew until 1959 (based at Laurence G. Hanscom Field, Massachusetts from November 1955). After a few months with Northrop F-89s, the 49th picked up McDonnell F-101Bs, moving to Griffiss AFB in July. Voodoos flew air defence missions for most of the 1960s, alert stand-down coming in July 1968 with inactivation following on 30 September.

The 49th FIS was reactivated later that same day, having acquired the assets of the 438th FIS from Kincheloe AFB, Michigan. Officially nicknamed the 'Cavaliers' (as its emblem depicted a knight in shining armour), the unit was also unofficially referred to as the 'Green Eagles', the subject of its aircraft's artwork.

On 8 September 1969, the squadron deployed to Alaska to replace the 84th FIS. In William Tell competitions, the 49th FIS scored second in the F-106 category in 1974, second in 1976, first in 1978, fourth in 1980, and first again in 1982. On 1 October 1979, the 49th FIS transferred to Tactical Air Command, with the rest of Air Defense Command's interceptor squadrons. By the mid-1980s it was the last active-duty USAF squadron flying the F-106. During its period of F-106 deployment, the 49th operated 23 airframes and lost five on operations. (The F-106 had the lowest accident rate for single-engined aircraft in USAF history.) The first of the unit's F-106s to be retired was 59-0065, which arrived at the Davis-Monthan AFB 'boneyard' on 12 January 1982; the last two (59-0062 and 59-0136) arrived on 9 July 1987. Plans to re-equip the 49th with McDonnell Douglas F-15s were scrapped, the unit inactivating on 1 July 1987.

The 49th reappeared again in 1993 as the 49th Flying Training Squadron, a fighter 'lead-in' unit flying AT-38Bs from Columbus AFB, Mississippi.

Convair F-106A Delta Dart
49th Fighter Interceptor Squadron 'Cavaliers'
24th Air Division
1st Air Force
Griffiss AFB, New York, 1986

Armament: Hitting a flea with a sledgehammer!
The F-106 was conceived as an interceptor of Russian bombers and, as such, was originally equipped with an all-missile armament. All were carried within a fuselage weapons bay, thus cutting down on drag. The primary weapon in the Delta Dart's arsenal was the McDonnell Douglas AIR-2A Genie unguided rocket, equipped with a 1.5-kT nuclear warhead. Genie had a flight time of about 12 seconds and a blast radius of 1,000 ft (305 m), and was carried in the rear of the Dart's weapons bay. For the head-on engagement of Soviet bombers, a guided missile was required. To this end Hughes developed the conventional variant of their nuclear AIM-26A Falcon for the F-106. Conventional AIM-4 Super Falcons equipped F-106s, a pair of AIM-4Es with semi-active radar homing filling the forward half of the weapons bay (initially), and a pair of AIM-4Gs, with infra-red guidance, to the rear flanking the Genie. For many years this configuration (known as Standard Area Intercept IV) was typical of air defence '106s, and included 360-US gal (1363-litre) drop tanks.

Modifications and upgrades
Project Broad Jump, completed in 1963, saw the fitting of an infra-red search and track (IRST) ahead of the cockpit, while the concurrent Project Dart Board (completed in 1962) added thermal flash hoods, a new Convair ejection seat and an engine modification intended to eliminate engine flame-outs.

Other improvements, carried out during 1966/67, included the installation of a TACAN, zero-zero ejection seats, air-to-air refuelling gear and larger, 'supersonic' 360-US gal (1363-litre) underwing tanks, the latter permitting overseas deployments such as the *Pueblo* crisis deployment to South Korea. The original tanks were of 230-US gal (871-litre) capacity, as fitted to the F-102A.

This aircraft is seen in Project Sixshooter configuration, an upgrade programme approved in 1969, but not applied to F-106As until the early 1970s. The most obvious changes implemented under 'Sixshooter' were the fitting of a General Electric M61A1 20-mm, six-barrelled cannon in the rear half of the weapons bay (in the space otherwise occupied by the AIR-2A Genie rocket) and a new 'blown' canopy in place of the original framed example. The M61 installation, first tested in an F-106A in 1972, was a legacy of the USAF's experiences in Vietnam and a recognition of the F-106's dogfighting abilities. The gun was removable; aircraft so-equipped were identifiable by the bulged fairing under the fuselage which provided clearance for the gun's rotating barrels. In the F-106A the Vulcan had a maximum rate of fire of 4,500 rounds per minute, less than the 6,000 rpm when installed in an F-4E due to limitations in its hydraulic pump which rotated the weapon.

A lead-computing gunsight and a radar homing and warning (RHAW) set were also fitted, but a planned electronic counter-countermeasures (ECCM) equipment upgrade failed to gain funding. Missile armament was also updated at about this time, the AIM-4Es being replaced by AIM-4Fs with improved accuracy and ECCM capability. A weakness of the Super Falcon was its lack of a proximity fuse, impact being necessary for detonation.

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The 'Sixes' that never were
Though the F-106 was subjected to a number of upgrade programmes during its service career, several particularly ambitious programmes planned were for the type, which either proceeded no further than a few test flights or were cancelled outright before 'hardware' was even contemplated.

In the late 1950s, a programme to improve the F-106's radar detection range was initiated, involving the fitting of a new parabolic radar scanner 40 in (102 cm) in diameter, in an extended radome some 5 ft (1.52 m) longer than that of the F-106A. Two aircraft (57-0239 and 57-0240) were modified to act as **YF-106C** radar systems and aircraft performance testbeds; after 10 flights by the first aircraft, the programme was cancelled. Had it proceeded, upgraded F-106As and Bs would have been re-engined with Pratt & Whitney JT4B-22 engines and redesignated **F-106C/D**, respectively. **F-106E/F** was another attempt to improve target detection capability, this time by fitting an entirely new radar set. Three antenna configurations were to be tested, housed in a new 9-ft (2.74-m) long radome, 4 ft (1.22 m) in diameter. This remained a paper project.

A proposal with much wider scope was the **F-106X**. This was an attempt to upgrade the entire aircraft as an alternative to purchasing the Lockheed YF-12, by fitting a new powerplant, avionics and 'look-down/shoot-down' radar and fire-control systems. Canard foreplanes were to be fitted aft of the cockpit, to improve handling.

F-106A-100-CO Delta Dart 58-0780
In a career that spanned over 33 years, 58-0780 served with the six ADC fighter interceptor squadrons and two ANG units, as well as the Air Defense Weapons Center. The aircraft's assignments were as follows:

4 November 1959	27th FIS, Loring AFB, Maine
22 June 1960	94th FIS, Selfridge AFB, Michigan
29 May 1969	71st FIS, Malmstrom AFB, Montana
7 June 1971	ADWC, Tyndall AFB, Florida
8 July 1971	319th FIS, Malmstrom AFB, Montana
10 Apr 1972	460th FIS, Grand Forks AFB, South Dakota
19 June 1974	171st FIS/191st FIG, Michigan ANG, Selfridge Field
26 July 1974	194 FIS/144th FIG, California ANG, Fresno Air Terminal
13 January 1984	49th FIS, Griffiss AFB, New York
22 June 1987	MASDC, Davis-Monthan AFB, Arizona (park code FN146 assigned)
13 December 1991	received for drone conversion (drone code AD166 assigned)
31 March 1992	accepted as QF-106A drone, Det 1, 82nd ATRS, Holloman AFB
9 March 1993	shot down on its first and only NULLO (Not Under Live Local Operation) mission by an AIM-7M missile

Operators
On 30 May 1959, the first F-106As were delivered to Air Defense Command's 539th FIS at McGuire AFB, New Jersey (replacing the F-86L), but it was the the 498th FIS at Geiger Field, Washington (taking delivery of its first aircraft just two days later, to replace F-102s) that was the first operational 'Six' unit. Initially, plans existed for sufficient production to equip 40 squadrons with the interceptor, but successive cuts reduced this to 14 units. Even with this considerably reduced complement, it was necessary to refurbish a number of early test aircraft to operational standard.

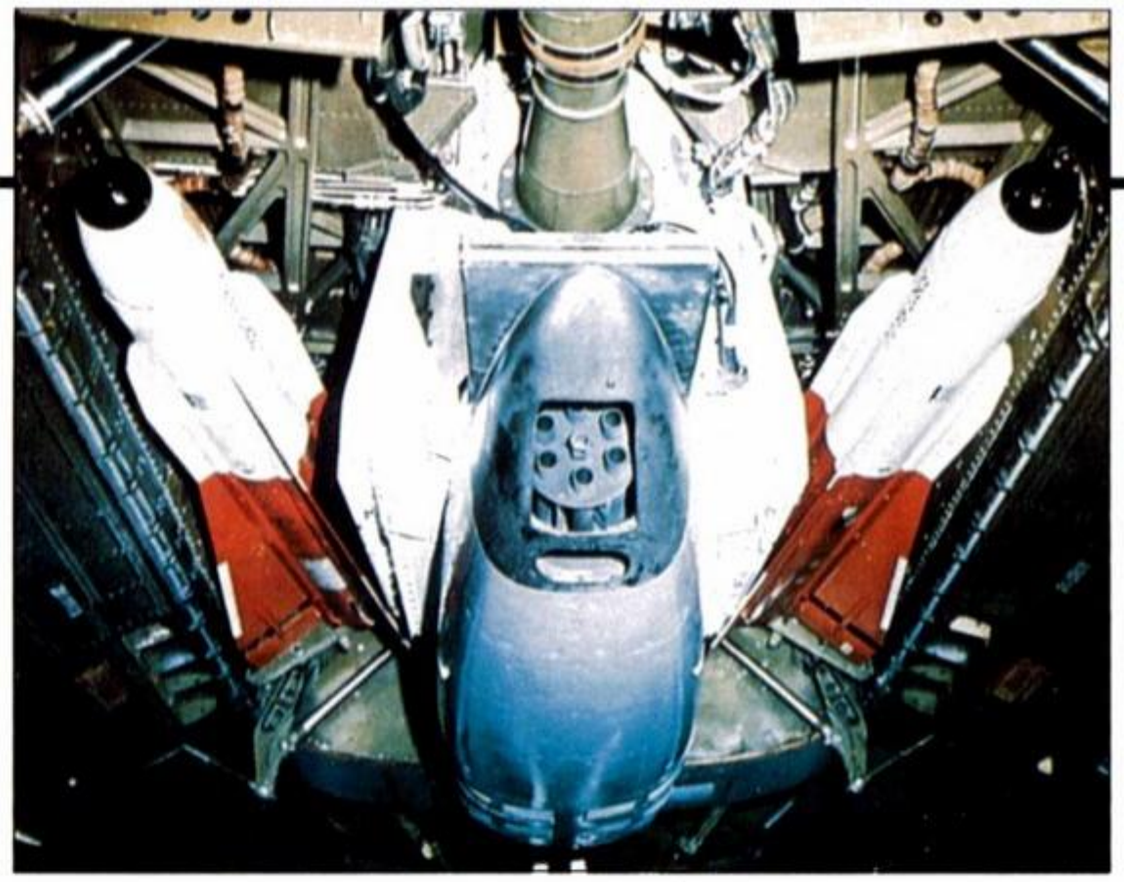
A total of 18 fighter interceptor squadrons was initially equipped with the F-106A (and the F-106B two-seat conversion trainer), four more in 1959, as follows: the 84th, 27th (redesignated the 83rd in 1971), 95th, 456th (redesignated the 437th in July 1968 and the 460th in September). The balance were equipped with the F-106 in 1960: 319th, 5th, 318th, 94th (redesignated the 2nd in 1971), 438th (redesignated the 49th in 1968), 329th, 71st, 11th (redesignated 87th in 1968) and 48th.

Air National Guard units, the last to operate the 'Six', began to receive these aircraft in 1972, beginning with the Montana ANG's 186th FIS, which flew the type until 1987. Other ANG units were the 194th FIS/California, which was so-equipped between 1974 and 1984, the 101st FIS/Massachusetts (1972-87), 171st FIS/Michigan (1972-78), 159th FIS/Florida (1974-88) and the 119th FIS/New Jersey (1973-88). The 119th was the last F-106 unit of all, dispensing with its last machines on 1 August 1998.

Powerplant
Initially, the F-102B was to be powered by a Wright J67 turbojet (a licence-built Bristol Siddeley Olympus) in place of the F-102A's Pratt & Whitney J57, but development delays of over 12 months forced a change in 1955 to an afterburning version of Pratt & Whitney's J75, about to fly in prototypes of both the Republic F-105 and Lockheed U-2 (in the latter without an afterburner). This engine (the commercial derivative of which was known as the JT4 and powered the first intercontinental Douglas DC-8s and Boeing 707s) was not without its teething problems, but was a safer bet than the British design.

The apparent indestructibility of the F-106's J75-P-17 (P-9 in early production aircraft) became the stuff of legend. It has been said that the engine would continue to function for as long as 15 minutes without lubricating oil, that it was immune to the effects of a bird strike and other FOD, and could lose compressor blades without apparent adverse effects.

F-106 details



F-106A Delta Dart cutaway

1 Pitot head
2 Radome
3 Radar scanner dish
4 Radar tracking mechanism
5 Hughes MA-1 weapons system radar unit
6 Radar mounting bulkhead
7 Pulse generator units
8 TACAN aerial
9 Angle-of-attack transmitter
10 MA-1 weapons system electronics units
11 Electronics bay access door
12 Infra-red detector fairing
13 Retractable infra-red detector
14 Knife-edged windscreen panels
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16 Instrument panel shroud
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18 Canopy external release
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22 Nose undercarriage wheel bay
23 Nosewheel door
24 Taxiing lamp
25 Twin nosewheels
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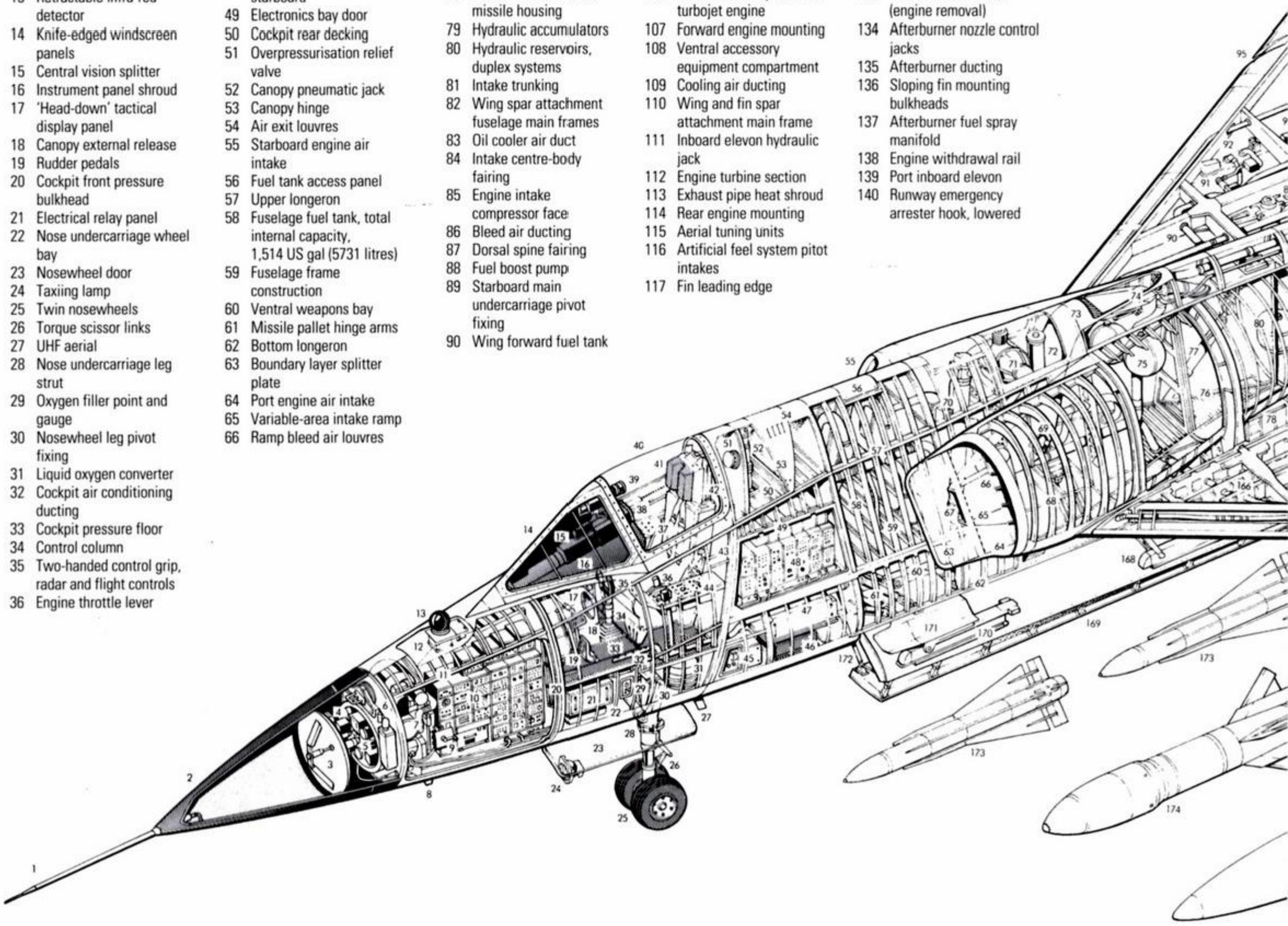
27 UHF aerial
28 Nose undercarriage leg strut
29 Oxygen filler point and gauge
30 Nosewheel leg pivot fixing
31 Liquid oxygen converter
32 Cockpit air conditioning ducting
33 Cockpit pressure floor
34 Control column
35 Two-handed control grip, radar and flight controls
36 Engine throttle lever
37 Pilot's ejection seat
38 Radar display
39 Optical sight
40 Cockpit canopy cover
41 Ejection seat headrest
42 Ejection seat launch rails
43 Cockpit rear pressure bulkhead
44 Side console panel
45 Ground power supply connections
46 Doppler navigation unit
47 Aft lower electronics compartment
48 Aft upper electronics equipment bays, port and starboard
49 Electronics bay door
50 Cockpit rear decking
51 Overpressurisation relief valve
52 Canopy pneumatic jack
53 Canopy hinge
54 Air exit louvres
55 Starboard engine air intake
56 Fuel tank access panel
57 Upper longeron
58 Fuselage fuel tank, total internal capacity, 1,514 US gal (5731 litres)
59 Fuselage frame construction
60 Ventral weapons bay
61 Missile pallet hinge arms
62 Bottom longeron
63 Boundary layer splitter plate
64 Port engine air intake
65 Variable-area intake ramp
66 Ramp bleed air louvres
67 Air conditioning system intake duct
68 Intake duct framing
69 Starboard side pressure refuelling connection
70 Forward missile pallet pneumatic jack
71 Air conditioning plant
72 De-icing fluid reservoir
73 Heat exchanger air exit duct
74 Air refuelling ramp door, open
75 Pneumatic system air bottles
76 Bifurcated intake ducting
77 Aft missile pylon pneumatic jacks
78 AIR-2 Genie air-to-air missile housing
79 Hydraulic accumulators
80 Hydraulic reservoirs, duplex systems
81 Intake trunking
82 Wing spar attachment fuselage main frames
83 Oil cooler air duct
84 Intake centre-body fairing
85 Engine intake compressor face
86 Bleed air ducting
87 Dorsal spine fairing
88 Fuel boost pump
89 Starboard main undercarriage pivot fixing
90 Wing forward fuel tank
91 Dry bay
92 Wing pylon mountings and connectors
93 Fuel system piping
94 Starboard wing main fuel tank
95 Leading-edge slot
96 Cambered leading edge
97 Wingtip fairing
98 Starboard navigation light
99 Outboard elevon
100 Elevon hydraulic jack
101 Elevon jack ventral fairing
102 Inboard elevon
103 Starboard wing aft fuel tank
104 Fuel system vent piping
105 Engine oil tank, 4.5 US gal (17 litres)
106 Pratt & Whitney J75-P-17 turbojet engine
107 Forward engine mounting
108 Ventral accessory equipment compartment
109 Cooling air ducting
110 Wing and fin spar attachment main frame
111 Inboard elevon hydraulic jack
112 Engine turbine section
113 Exhaust pipe heat shroud
114 Rear engine mounting
115 Aerial tuning units
116 Artificial feel system pitot intakes
117 Fin leading edge
118 Tailfin construction
119 Air-to-air identification (AAI) aerial
120 Fintip aerial fairing
121 UHF/TACAN aerial
122 Tail navigation light
123 Rudder
124 Rudder honeycomb construction
125 Split airbrake panels
126 Airbrake pneumatic jacks
127 Brake parachute housing
128 Rudder hydraulic jack
129 Rudder trim and feel force control units
130 Airbrake open position
131 Divergent exhaust nozzle
132 Variable-area afterburner exhaust nozzle
133 Detachable tailcone (engine removal)
134 Afterburner nozzle control jacks
135 Afterburner ducting
136 Sloping fin mounting bulkheads
137 Afterburner fuel spray manifold
138 Engine withdrawal rail
139 Port inboard elevon
140 Runway emergency arrester hook, lowered
141 Port outboard elevon
142 Elevon rib construction
143 Honeycomb trailing-edge panels
144 Port navigation light
145 Honeycomb wingtip fairing
146 Outboard elevon hydraulic jack
147 Port wing integral fuel tank bays
148 Machine wing spars
149 Machined main undercarriage mounting rib
150 Wing rib construction



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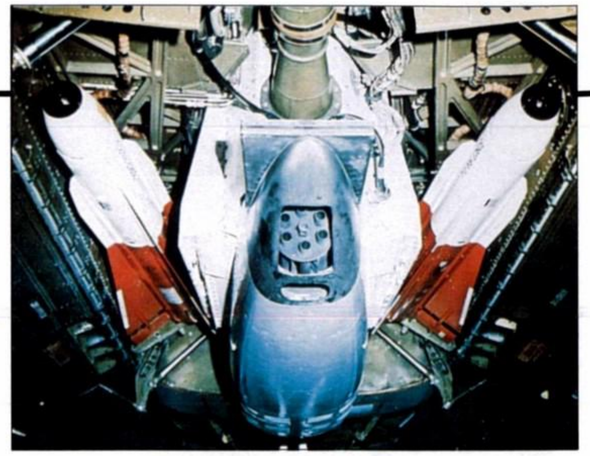
F-106 details



Far left: F-106B 57-2530 of the 539th FIS is seen here at McGuire AFB in 1966 with a full set of IR-guided AIM-4Gs on its lowered rails.

Left: The M61 gun installation neatly filled the space left between the rear pair of Falcons, after the deletion of the Genie. The prototype installation is shown here. The limited capacity of the M61's Vickers hydraulic drive held the gun's rate of fire to 4,500 rpm.

Douglas's AIR-2 Genie unguided nuclear rocket was introduced on the F-89J and later equipped both the F-101 and F-106. It had a top speed of just over Mach 3, a range of 6 miles (10 km) and a weight of 820 lb (372 kg). A broad blue band around the centre of the rocket's body would indicate a training round.

F-106A Delta Dart cutaway

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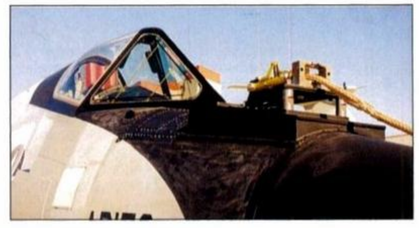
152 Leading-edge slot
153 Port wing pylon connectors
154 Mainwheel leg door
155 Port mainwheel
156 Torque scissor links
157 Landing lamp
158 Main undercarriage leg strut
159 Drag brace and pneumatic brake reservoir
160 Main undercarriage leg pivot fixing
161 Breaker strut
162 Hydraulic retraction jack
163 Main undercarriage wheel bay
164 Mainwheel doors
165 Emergency ram air turbine
166 Port wing forward fuel tank bay
167 Fuel system vent pipe
168 Aft single missile pylon, port and starboard, lowered position
169 Weapons bay doors, open
170 Missile launch rail
171 Forward twin missile pallet
172 Weapons bay door pneumatic jack
173 AIM-4F Falcon air-to-air missile (4)
174 Single AIR-2A Genie air-to-air nuclear missile
175 Missile folding fins, deployed position
176 Port wing pylon
177 227-US gal (859-litre) external fuel tank

Above: F-106A 59-0043 of the NJ ANG demonstrates the straightforward removal of its J75 for servicing.

Behind the F-106's open speed brake was the braking parachute housing. This aircraft of the 49th FIS sports a colourful exhaust cover for William Tell 1982.

The QF-106A/EXD-01 Eclipse tow-launch demonstrator, 59-0130, sported this attachment and release mechanism, modified from B-52G drag chute release gear, for a 'tow rope' (actually Vectran synthetic rope).



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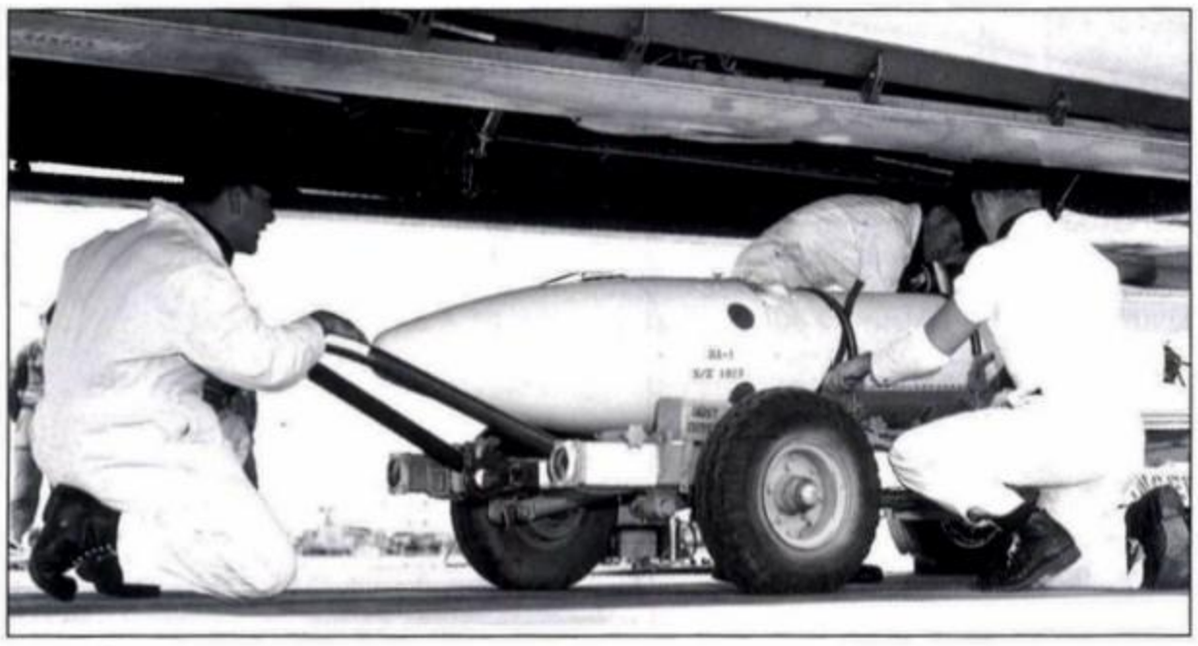
Far left: F-106B 57-2530 of the 539th FIS is seen here at McGuire AFB in 1966 with a full set of IR-guided AIM-4Gs on its lowered rails.

Left: The M61 gun installation neatly filled the space left between the rear pair of Falcons, after the deletion of the Genie. The prototype installation is shown here. The limited capacity of the M61's Vickers hydraulic drive held the gun's rate of fire to 4,500 rpm.



Douglas's AIR-2 Genie unguided nuclear rocket was introduced on the F-89J and later equipped both the F-101 and F-106. It had a top speed of just over Mach 3, a range of 6 miles (10 km) and a weight of 820 lb (372 kg). A broad blue band around the centre of the rocket's body would indicate a training round.

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Behind the F-106's open speed brake was the braking parachute housing. This aircraft of the 49th FIS sports a colourful exhaust cover for William Tell 1982.

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151 Cambered leading edge
152 Leading-edge slot
153 Port wing pylon connectors
154 Mainwheel leg door
155 Port mainwheel
156 Torque scissor links
157 Landing lamp
158 Main undercarriage leg strut
159 Drag brace and pneumatic brake reservoir
160 Main undercarriage leg pivot fixing
161 Breaker strut
162 Hydraulic retraction jack
163 Main undercarriage wheel bay

164 Mainwheel doors
165 Emergency ram air turbine
166 Port wing forward fuel tank bay
167 Fuel system vent pipe
168 Aft single missile pylon, port and starboard, lowered position
169 Weapons bay doors, open
170 Missile launch rail
171 Forward twin missile pallet
172 Weapons bay door pneumatic jack
173 AIM-4F Falcon air-to-air missile (4)
174 Single AIR-2A Genie air-to-air nuclear missile
175 Missile folding fins, deployed position
176 Port wing pylon
177 227-US gal (859-litre) external fuel tank

F-106A cockpit

Right: As built, the F-106A's cockpit was of so-called 'round eye' configuration with dial-type instruments. Under the hood above the instruments is the radar scope; the larger scope below is the tactical situation display (TSD). Note the two-handled control column, chosen by the USAF after conventional and sidestick combinations were evaluated on early production F-106s. The left-most of the two grips controlled the radar.

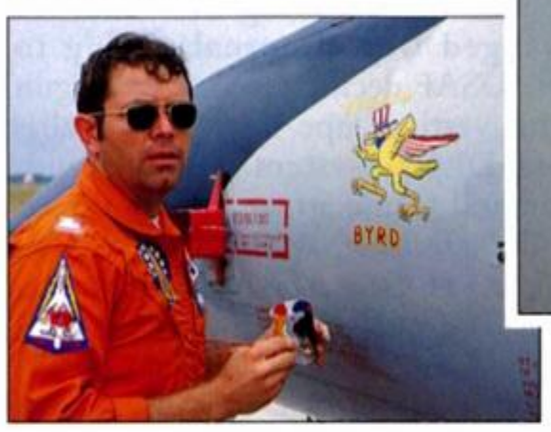
Far right: A redesigned instrument panel (the IID or integrated instrument display), with vertical tape instruments, was introduced on the production line beginning with aircraft 58-0759. Some (but by no means all) earlier aircraft were retrofitted to this standard. Here the cockpit of a QF-106A is shown. Note the absence of the TSD, and the Remote Flying Enable Box or 'NULLO Consent Panel' fitted in place of the radar scope, used by the safety pilot to switch control of various aircraft functions to ground controllers.

Left: The IRST (infra-red search and track) ahead of the cockpit was installed under Project Broad Jump in 1963. This aircraft also sports the clear-view bubble canopy introduced from October 1972 to improve all-round visibility.

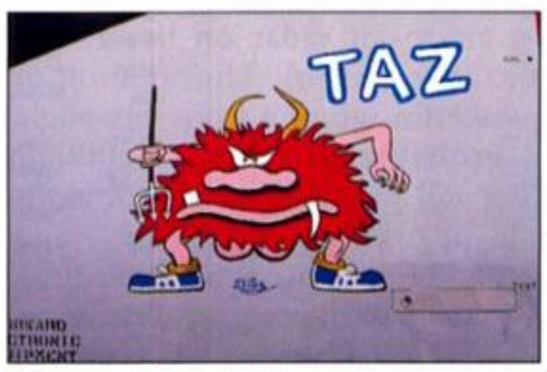
'Six' nose art

Examples of colourful F-106 nose art are associated particularly with the William Tell competitions of the 1970s and 1980s. Designs often followed a squadron-related theme – for example, the 'red bulls' of the 87th.

48th FIS



59-0133, **Broadway Byrd** *and artist.*



Above: **TAZ** *was seen on 59-0145 and other 48th FIS aircraft*

Above: **Patience** *adorned 59-0123*

Above: 56-0458 of the 48th FIS

87th FIS

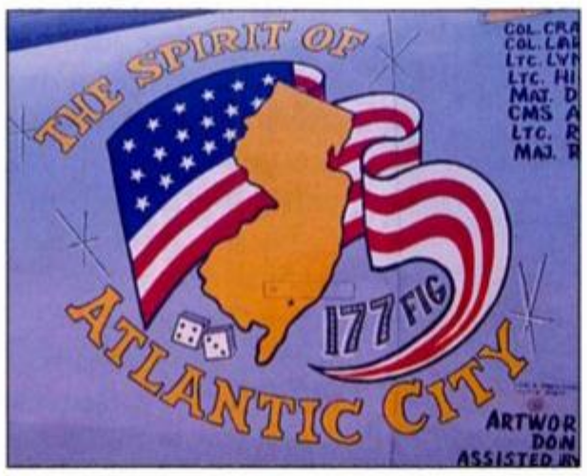
Above: 59-0089 was **Lurch IV** *with the 87th FIS (known as 'The Red Bulls' after the 11th FIS) at William Tell '72.*

Above: **The City of Marquette** *was 59-0091, an 87th FIS machine in 1972, named for the city near the 87th's base, K. I. Sawyer AFB.*

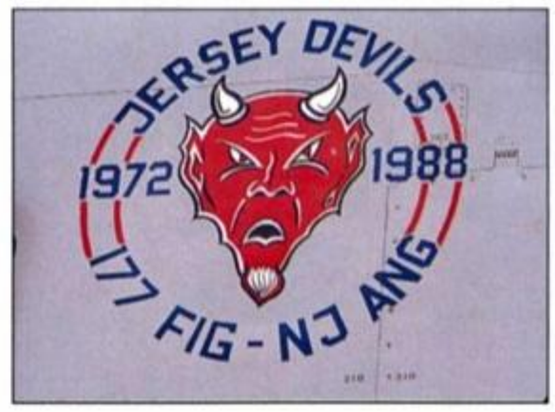
Left: 57-0230 of the 87th FIS displays another variation on the 'red bull' theme.

Above: **Bones Crusher** *was 59-0094 of the 87th FIS, seen at Tyndall AFB in September 1972, just prior to that year's William Tell meet.*

119th FIS



177th FIG NJ ANG
ADWC 2 FIS 5 FIS 11 FIS 27 FIS 48 FIS 49 FIS
NASA 71 FIS 83 FIS 84 FIS 87 FIS 94 FIS 95 FIS
101 FIS 119 FIS 159 FIS 171 FIS 186 FIS 194 FIS
318 FIS 319 FIS 329 FIS 437 FIS
438 FIS 456 FIS 460 FIS
498 FIS 539 FIS



The last F-106 in service, 59-0043 of the 177th FIG (119th FIS/New Jersey ANG), sported an array of nose designs, including a list of F-106 units, a shark-mouth and a squadron insignia.

The YF-106C was the only version other than the A and B to actually reach the hardware stage. Its only differences from the F-106A were a 40-in (102-cm) nose radar dish and a 5-ft (1.52-m) nose extension. Two were built, but only one flew with these modifications. The static test airframe (above) was later returned to standard configuration.

Above: In the latter days of the F-106, air combat manoeuvring became an important part of its repertoire. Seen returning from a 1985 ACM mission off Florida are 159th FIS Darts and VA-72 A-7Es from Cecil Field.

Below: A B-52G leads an echelon of 119th FIS F-106s. Since 1981, when this scene was captured, the parent commands of these aircraft (SAC and ADTAC) have merged into Air Combat Command, and the 'Six' has gone, as has the B-52G. The only real link to the present is the 119th FIS, still flying fighters (F-16Cs) at Atlantic City.

prototype (58-0795) to ADC, the aircraft was flown in the speed range of 165 KCAS to 1.9 Mach and from -3 *g* to +7 *g*, with no change in hinge moment due to gun firing. Thereafter, 58-0795 stopped briefly at Peterson AFB, Colorado (adjacent to ADC headquarters) where General Agan and other officials could look at it before it proceeded to Tyndall for Category III trials. After ADC assumed this test flight effort from Convair, the gun-armed prototype flew 20 sorties, including 18 against a TDU-10B Dart target towed by an F-100 Super Sabre and two against a Martin MQM-13A (TM-76A) Mace surface-to-surface missile. Missions against the Mace were flown at 10,000 ft (3048 m) and at 370 KCAS. Prior to the firing pass, the Mace was accelerated to 500 KCAS and put into a 45° banked turn. The F-106 pilot shot it down easily with HEI (high-explosive incendiary) ammunition but the aircraft sustained dents and 'dings' when it flew through the Mace explosion.

Tests showed that the Vulcan gun vibrations did not harm the AIM-4F/G Super Falcon missiles. Four missiles were carried on the gun sorties, then fired without a hitch on a subsequent mission.

The initial Six Shooter F-106A also evaluated the clear-top canopy sometimes referred to (not quite accurately) as a 'bubble' canopy. The new design eliminated the metal strip above the pilot's head that corresponded to the centreline of the aircraft. The new canopy was made from a single piece of ¾-in (1.9-cm) cast acrylic Plexiglas formed to extend over the top, with the sides bowed out at the pilot's head. The Plexiglas piece was designed to fit in the existing canopy structure, with the canopy edges reinforced by an Orlon cloth laminate. The canopy apparently was tested primarily on the second Six Shooter aircraft (59-0092), initially with an air speed restriction of Mach 1.5 and a height restriction of 25,000 ft (7620 m), both of which were later lifted. No canopy defog was provided. Six pilots made 23 flights with the new canopy and reported a 100 per cent increase in visibility. By the time the flight test effort was completed, on 19 September 1972, the 20-mm cannon was scheduled for some F-106s (those which also received vertical tape cockpit instruments) and the canopy for all.

Gun package

The gun system was installed as a package into an enclosure which supported it in the F-106 missile bay and provided an aerodynamic shield for the portion of the gun protruding below the missile bay. Taking into account considerations which ranged from internal wiring to service-life expectancy, the USAF decided to install the gun only on those F-106s with vertical tape instruments, alias the Integrated Instrument Display system. Aircraft with analog instruments, no gun and Genie armament continued to serve. Nearly two decades later, the last units to fly these models were ANG squadrons at Otis AFB, Massachusetts, and Great Falls, Montana. (The nuclear commitment with the Genie ended in 1985.)

Tactics were designed to catch cruise missile carriers (Soviet bombers) 600-800 miles (966-1287 km) from shore (ADC did not believe the air-to-air radar on the F-106 would detect a cruise missile after launch). The addition of the gun gave the F-106 a powerful weapon from any angle – from behind, it could probably match the 6,000-ft (18280-m) reach of a Soviet tail gun despite the obvious advantage the latter enjoyed by shooting backward – and especially when an attack could be mounted forward of the bomber's 'gun line'. F-106 pilots practised group attacks on 'Bisons' and 'Bears' with one Delta Dart each in the two o'clock and 10 o'clock positions. By 'stitching' (firing cannon bursts from the side), the F-106 pilots could rip asunder the hydraulics and control lines of a large Soviet bomber. This, of course, was not the first method of attack – Falcon missiles had a reach of up to about 10 miles (16 km) – but it added flexibility to the job of intercepting attackers. Ironically, this was to prove useful at a time when bombers were acquiring stand-off capability and greater stress was placed on catching them farther from target, but the gun's capability was never to be used in actual fighter-versus-fighter action.

As for Archibald's suggestion that the F-106 receive tactical camouflage, no Delta Dart was ever painted in the green/brown T.-O. 114 camouflage employed by tactical aircraft in Vietnam. Archibald may have turned down the idea after talking to an Army helicopter pilot, freshly home

Convair F-106A-CO-100 Delta Dart 159th FIS, Florida Air National Guard Jacksonville, circa 1981

ADC career
58-0786 served for nearly 40 years with the USAF. Delivered to the 4750th Air Defense Wing at MacDill AFB on 26 October 1959, it moved within Florida on 5 June 1960 to the 73rd Air Division at Tyndall AFB. It served there until 26 May 1969 when it was assigned to the 94th FIS at Selfridge AFB, Michigan. In July 1971, it went to the 71st FIS at Malmstrom AFB, Montana. The 319th FIS inherited the 71st's aircraft at Malmstrom iin April 1972. 58-0786's final regular ADC assignment was to the 460th FIS at Grand Forks North Dakota on 6 April 1972.

Planform
YF-106s had the same boundary-layer fences as the F-102A, but production aircraft had a slot in the leading edge which performed the same function more efficiently. Apart from this, the wing shape of the Delta Dart was virtually the same as that of the Delta Dagger. The most noticeable difference in plan view was the more streamlined fuselage and the movement of the intakes aftward to a position closer to the leading edge of the wing.

Unit history
The 159th FIS (today the 159th FS) can trace its lineage to the 352nd FS based at Raydon with P-47s and P-51s as part of the 353rd Fighter Group. In 1946, the squadron was redesignated as the 159th FS and allocated to the Florida ANG at Jacksonville, equipped with P-51Ds and, later, F-80Cs. As the 159th FBS, the squadron took part in the Korean War flying F-84Es. On return to the US and State control, the unit flew Mustangs (F-51D and H) and P-80Cs again before converting to the F-86D in 1956 and taking on the interceptor role. The first F-102As arrived in July 1960 and F-106As in mid-1974. The F-106 era lasted until 1987 when the squadron converted to the F-16A/B, which it flew until transitioning to the F-15A/B in the mid-1990s.

Performance
Due to its bigger engine (50 per cent more thrust) and more refined shape, the F-106A had a top speed almost twice that of the F-102A; 1,525 mph (2454 km/h) at 40,000 ft (12192 m) versus 825 mph (1328 km/h) at 36,000 ft (10793 m). In initial tests, however, the acceleration of the Dart left something to be desired, the aircraft taking 4.5 minutes at 57,000 ft (17374 m) to go from from Mach 1.0 to Mach 1.7 and a further 2.5 minutes to reach Mach 1.8. This was cured by revising the intake configuration, enlarging the frontal area and thinning the lips.

With the Guard and beyond
'786 became a 'Guardsman' on 7 June 1974 when It joined the 119th FIS, New Jersey ANG. At some point after this, it went to the159th FIS, Florida ANG, although the date is unclear. On 29 December 1986, it returned briefly to the New Jersey Guard, leaving it on 24 February 1987 for storage at AMARC. On 11 October 1991, it was accepted as a QF-106 at Holloman AFB. On 25 September 1997, after nine unmanned flights (and numerous manned ones), it was terminated from the drone programme due to a cracked no. 3 spar on the right wing.

The ultimate F-106 squadron was the 119th FIS from New Jersey. Here, a quartet of 'Jersey Devils' promenades above the Atlantic City boardwalk. In 1988, the 119th bowed to the inevitable and sent the last active F-106s to the 'boneyard' at Davis-Monthan.

from 'Nam, who complained of flying a "big brown bug in a big blue sky," thereby inviting considerable attention from the Viet Cong. According to Archibald, one ship was camouflaged in a light blue air-to-air camouflage scheme at Tyndall, where everyone said it looked 'too white' compared to the standard ADC scheme. In due course, it was determined that this paint scheme offered no advantages. No-one knew it at the time, but the improvements that were adopted – gun, clear-top canopy, air-refuelling capability, supersonic tanks – never did reach Vietnam, although they would prove useful farther north on the Asian continent.

The original gun test ship (58-0795) was subsequently tested with a variation of the AGM-78 Standard ARM (anti-radiation missile) under the right wing in the Spike programme, which involved early attempts to create an anti-satellite weapon.

On 31 August 1967, after nearly a decade in the 'Six' business, the USAF inactivated its first Delta Dart squadron, the 539th FIS at McGuire AFB, New Jersey.

Infra-red seeker

It was about this time that the F-101B Voodoo, F-102A Delta Dagger and F-106A Delta Dart acquired a Hughes IRST device on the nose centreline in front of the windshield. Unlike those on the Voodoo and Dagger, the F-106's IRST was retractable. The device was always vulnerable to temperature and weather conditions, and would home in on the outline of a thundercloud, but it did give pilots an extra tool to locate a heat source from another aircraft. Pilots regarded this capability as valuable in a situation where the adversary was dumping chaff to foil air-to-air radar. The device was initially fussy to prepare for a flight, since it was serviced with liquid nitrogen; in time, this arrangement was replaced by a closed-cycle cooler that generated nitrogen.

During this period, the F-106, which had always had the option of carrying external wing tanks, acquired newly-designed underwing tanks, often referred to as 'supersonic tanks', that could be carried by the aircraft at any speed. These 360-US gal (1362-litre) tanks carried on pylons beneath the centre wing had fully 50 per cent greater fuel capacity than the less frequently-used 227-US gal (859-litre) external containers originally designed for the Delta Dart. The 'supersonic tanks' were jettisonable, but the capability was rarely used; they were carried on any mission except the shortest-ranged intercepts.

Together with the new tanks, the USAF retrofitted inflight-refuelling capability to all surviving F-106s by installing a slipway receptacle in the dorsal position behind the pilot. This idea pre-dated General Agan, Archibald's suggestions, and the *Pueblo* incident (see next paragraph). Some three years earlier, a feasibility study (initiated on 4 October 1965 and concluded on 30 November 1965) determined the ideal location for the receptacle (at the location known as 'Station 364') based on mating with a flying boom refuelling device extended at 30° by a KC-135 Stratotanker. The study was apparently primarily a paper exercise, although mating test flights and a 'simulated hook-up' were carried out with a KC-135 and an unmodified F-106B. The Delta Dart fleet did not actually equip with refuelling receptacles (installed at depot level) until 1967,

Right: To protect stored aircraft from moisture and dust, a protective coasting called Spraylat was used. This F-106B was trialled with an overall coat of Spraylat. It was found to be more cost-effective (in application and removal) to seal only canopies and joints where foreign matter might find its way in.

To the 'boneyard'

As the F-106 was phased out of the ADC squadrons, and then the ANG, most, if not all, surviving aircraft found their way to the Aerospace Maintenance and Regeneration Center (AMARC – known as MASDC until 1985) at Davis-Monthan AFB in the Arizona desert. The first F-106, a 48th FIS aircraft, arrived for storage on 12 January 1982, and more than 100 were parked in open storage by the end of 1985 when the USAF announced Pacer Six, a programme to convert more than 200 aircraft to pilotless drone configuration. The first aircraft left the 'boneyard' for conversion by Tracor Flight Systems at Mojave in October 1986.

Right and far right: Retired F-106s await conversion to aerial targets at AMARC in July 1987. Ex-5th FIS Dart 59-002 (far right) became a QF-106 in February 1991 and was shot down at Tyndall the following March. 59-0102, ex-87th FIS (right), lasted until 2 July 1997 when it was claimed by an AIM-120.

B-1B chase

One of the last users of the F-106 was the Contract Management Division of Air Force Systems Command, which used seven Delta Darts (four As and three Bs) as chase aircraft for the Rockwell B-1B acceptance test programme out of Palmdale, California. They replaced Edwards AFB F-111s in this role from October 1986 until June 1990, accompanying every bomber built in this period on its pre-delivery flights, as well as acting as support for flights out of Tinker AFB, Oklahoma. When B-1B production ended, the Darts became QF-106 drones.

Above left: The colour scheme used on the B-1B chase programme aircraft changed several times. Initially, it was this simple marking on a red tail fin.

Above: A typical four-hour B-1B acceptance flight required two F-106s, which switched at the half-way mark.

Left: One of the three F-106Bs used awaits its fate as a drone.

when General Agan was pondering a contribution to the Vietnam War. 20 November 1967 marked the first air-to-air refuelling of the F-106 when the 318th FIS, McChord AFB, Washington deployed to Tyndall with 10 F-106s. No-one predicted that the F-106's war contribution would occur, instead, in Korea.

Crisis in Korea

At the very time when 200 Americans per week were returning from Vietnam in body bags, tensions were high in Korea. There, an attempt to assassinate South Korean President Park Chung-hee on 21 January 1968 was followed two days later by North Korea's seizure of the spy ship USS *Pueblo* (AGER-2). It was a difficult and embarrassing time for the US, which has always argued that it can fight two wars at once, but has never been able to do so: the only tactical air power in Korea consisted of F-4 Phantoms on nuclear alert, and they were unable to alter their operations quickly enough to 'cap' the *Pueblo*. Overnight, a massive build-up of US air power in Korea began, marking the first and only time the F-106 would be employed overseas for a sustained period of time.

Fortunately, in the months before the *Pueblo* fiasco, ADC had been planning to apply lessons learned in Alaska by developing the potential to deploy its interceptors to other locations in an emergency. The College Cadence plan was developed by ADC in the spring of 1967, under which a force of 24 F-106As (consisting of six aircraft each from the 71st, 94th, 95th and 318th FIS) was tasked to be ready for worldwide deployment. All the F-106s of these four squadrons were equipped with new supersonic fuel tanks and inflight-refuelling capability.

College Cadence F-106 deployments to Osan Air Base, south of Seoul, began with the arrival of 318th FIS Delta Darts on 18 February 1968 after they had staged through Naha, Okinawa a week earlier. For a time, it had seemed that a new invasion of South Korea was imminent, at the very time when Americans were battling through the Tet Offensive in Vietnam. The invasion did not take place and, in due course, the *Pueblo* crew was released in December 1968, but tensions remained high. North Korean MiG-17 'Fresco' fighters shot down a US Navy EC-121 Constellation on 15 April 1969, killing all 31 on board. So the F-106 role in Korea continued until 1 May 1970. Over 27 months, more than half a dozen ADC squadrons contributed aircraft and/or airmen to the Delta Dart presence in Korea. At times, the F-106s were apparently in the air within minutes' flying time of North Korea's MiG-17s and MiG-21s, although neither side's fighters crossed the line.

ADC had a number of contingency plans for other F-106 deployments abroad. College South was aimed at Cuba. College Green was intended to provide an air defence of Ballistic Missile Early Warning System radar sites in Greenland. College Tap, which applied to 18-24 aircraft at Tyndall, would have 'tapped' F-106s assigned to training duties to serve as combat interceptors in an emergency. College Key was a different measure aimed at Cuba and involved planned deployments to Key West, Florida. None of these was ever put into effect.

There was renewed interest in the ageing F-106 at this juncture, in part because Korea had reinforced pilots' long-standing contention that the aircraft had excellent potential for fighter-versus-fighter combat. The manufacturer was interested in exploiting this, but was also pushing for a more advanced interceptor version. In 1968, Convair, by then a division of General Dynamics, suggested a version known on paper as the F-106X, a basic F-106 that would feature a new radome and a larger radar antenna. It would also receive a modified fire control system (providing a look-down capability) and a new air-to-air missile (with shoot-down capability). Some illustrations from the era depict an aircraft with canard surfaces just forward of the delta wing, and significantly revised air intakes. The F-106X was a competitor to the long-range Lockheed YF-12 interceptor (itself a close cousin of the SR-71 Blackbird) which ADC wanted but which posed unparalleled technical and financial challenges.

F-106E/F

Later that year (on 3 September 1968), Convair made a detailed proposal for an F-106E/F 'improved interceptor' that was less ambitious than the F-106X but still quite versatile. The company was looking at "the post-1972 ConUS [Continental United States] aerospace defence environment" with an F-106E/F "compatible with the airborne warning and control system (AWACS) and over-the-horizon (OTH) radar defence network." Improvements in the F-106E/F would have included look-down/shoot-down radar and missile launch capability, a two-way UHF voice and datalink radio, and both nuclear and non-nuclear missiles including the AIM-26 Nuclear Falcon and/or the AIM-47.

On 9 February 1968, Defense Secretary McNamara (then serving under President Johnson) overruled the USAF, killed plans for a purchase of Lockheed F-12A interceptors and announced that the F-106 would remain the premier interceptor for the defence of the US. McNamara's announcement gave new impetus to plans to upgrade and improve the fleet of existing F-106s and also bolstered General Dynamics' hopes of selling the advanced

Above: This line-up of (mostly ex-5th FIS) aircraft was seen at Holloman in late 1996. 58-0793 was one of the lucky few, being retired to AMARC in February 1998.

Below: Ground crew prepare a QF-106B for a flight at Tyndall. In the background is a QF-100, the type that bridged the gap between the Pacer Deuce (PQM-102) and Pacer Dart (QF-106) programmes.

QF-106 FSAT

The last large-scale use of the F-106 was as an unmanned target drone or Full-Scale Aerial Target (FSAT). Four batches – of 46, 48, 48 and 31 aircraft – were converted to QF-106 FSATs, making a total of 173 production (and two prototype) aircraft. The first pre-production QF-106 was delivered in September 1989 and the last aircraft in December 1994. Responsibility for operating the drones fell to the 82nd Tactical Aerial Targets Squadron (TATS), later Aerial Targets Squadron (ATS), part of the 475th Weapons Evaluation Group (WEG). The 82nd was based at Tyndall with a permanent detachment at Holloman AFB, New Mexico and, in addition to providing unpiloted targets for live weapons engagements, carried out a wide range of test work, approximately 90 per cent of QF-106 flights being 'under live local operation' (i.e., manned). QF-106 operations ceased at Holloman in February 1997. The last QF-106 was shot down there on 28 January 1998.

Top: A (manned) QF-106B trundles to the end of the Holloman runway, followed by the Manned Mobile Van, which provided back-up to the main control system at a remote site.

Above: QF-106As and Bs line up on 'death row' at Tyndall in 1992. The rudders reveal numerous previous owners, including a Contract Management Division B-1 chase aircraft. Today this ramp is filling with QF-4 Phantoms.

F-106X. This led, among other things, to an exhaustive study of an F-106 variant armed with the AIM-47 missile developed for the YF-12A. In the end, expectations of a 'new-build' F-106 of the 1970s proved in vain.

The first ANG recipient of the F-106 was the 186th FIS of the Montana ANG at Great Falls, which took delivery of its first two aircraft (57-2485 and 57-2487) on 3 April 1972. The unit also became the first ANG squadron to lose an F-106 (57-2520), in a mishap on 3 October 1972.

An unusual overseas deployment by the F-106 occurred on 21 April 1978 when the 87th FIS went to Keflavik, Iceland to stand guard until 13 May 1978.

Replacement and (temporary) retirement

By this time, the F-15A Eagle was appearing as a potential replacement for the F-106 (on 14 August 1981, the 48th FIS at Langley became the first F-106 unit to receive an F-15) and it was apparent that the 1980s was the final decade for the Delta Dart. The first F-106 to go to the USAF's 'boneyard' in Arizona – the Aerospace Maintenance and Regeneration Center at Davis-Monthan AFB, nominally a storage facility, but in a sense a grave – arrived on 12 January 1982. The ex-48th FIS F-106A (59-0116) was assigned storage number FN001 – the first of many.

Another sign of the impending end was the final participation of the F-106 in the semi-annual William Tell gunnery competition, when the 119th FIS (New Jersey ANG) took part during 2-27 October 1984.

The end of the line came, finally, when the last three F-106s departed the Atlantic City-based 119th FIS on 1 August 1988. Many Delta Dart airframes were still far short of the 10,000 flight-hour lifetime that was official policy at this time (originally, the projected lifetime had been a mere 3,300 hours), but there was no longer a place for them in the interceptor world, by now populated with F-4 Phantoms and, soon, F-15 Eagles and F-16 Fighting Falcons. The F-106 story was not quite over, however, for there lay ahead duty as a chase aircraft, as an unpiloted target drone, and ultimately as a towed stand-in for a future space vehicle.

In 1986, Flight Systems, Inc. (later Honeywell) began the Pacer Six programme to convert 194 F-106s stored at Davis-Monthan into target drones to replace the QF-100D/F Super Sabre and PQM-102 Delta Dagger. Initial work took place at Mojave, California and the first flight of a QF-106A occurred in July 1987. Following the completion of an initial batch of 10 QF-106As in 1990, responsibility for major portions of the work was shifted to the USAF itself. This was performed before the aircraft were removed from storage at the AMARC; further work was undertaken in East St Louis, Illinois. Commencement

Far right: One of the last Delta Dart pilots, Lt Col Robert 'Buzz' Sawyer (Ret) climbs into a QF-106B. A contract pilot with Lockheed Martin, Sawyer has over 1,800 F-106 hours, most of it with ADC squadrons. The blue 'horn' on the fuselage is part of the Airborne Electronic Threat Simulator (AETS), which was added to some aircraft. The 'high hour' pilot of the F-106 was Lieutenant Colonel Charles ('Chuck') Townsend, who logged 4,410.6 hours between 1968 and 1988. No other pilot exceeded 4,000 hours in the Dart.

of conversion of the 11th and subsequent aircraft was delayed from May 1991 to September 1991 by technical problems, then proceeded smoothly.

In late 1991, the QF-106A began operating as the USAF's FSAT (full-scale aerial target), first at the White Sands Missile Range, New Mexico and thereafter at the Eglin Gulf Test Range, Florida (based at Holloman and Tyndall). The 82nd Tactical Aerial Targets Squadron at Tyndall (with a detachment at Holloman) was the operator of the QF-106A, which was deemed better able to simulate an enemy aircraft for air-to-air missile engagements because of its higher speed and greater manoeuvrability.

As with earlier FSATs, a typical mission employed the QF-106A as a target for an air-to-air test of an infra-red missile and was flown 'nullo' (not under live local operation). The QF-106A was controlled by ground operators. The intention was for the QF-106A target drone to survive repeated engagements with air-to-air missiles. The QF-106A could, of course, be flown with a pilot aboard.

The delta wing of the QF-106A made it impossible for the aircraft to the employ wingtip propane burners used on earlier drones to create an IR source for heat-seeking missiles. The burners were placed on pylons located beneath the wing and rather far forward. This proved less than fully satisfactory, in part because in most test-range missile engagements the missile is fired down at the target.

The Holloman detachment alone flew more than 300 nullo QF-106 missions. Typical was 1996 when, of 367 missions flown at Holloman, 40 were unmanned and 14 drones were actually shot down at nearby White Sands. The final shoot-down of a Convair QF-106 Delta Dart drone at Holloman occurred on 20 February 1997. Det 1 of the 82nd ATS flew the terminal mission. The aircraft was a QF-106B (serial 57-2524). The mission was an IR countermeasures effort and the aircraft was shot down over the nearby White Sands Missile Range by a Russian-made SA-18 'Grouse' (9K-38 Igla) operated by the US Army. The last Tyndall-based drone flew the last nullo mission on 28 January 1998. QF-106A 59-0051 clung tenaciously to life – hit by an AIM-120 AMRAAM, it staggered on, and survived hits from 20-mm cannon. Finally it was brought down by an AIM-9M Sidewinder, thus effectively ending 39 years of unit-strength USAF operations with the Delta Dart. Today, the QF-106 has been replaced by QF-4 Phantom drones.

Delta dragger

The final mission assigned to the F-106 Delta Dart was to participate in Project Eclipse, a joint project of NASA and the USAF at Edwards. Using the final flyable QF-106A (59-0130), with a second aircraft (59-0010) as a back-up, the programme demonstrated technology for an RLV (reusable launch vehicle) to carry payloads into orbit. The F-106 was towed aloft by a NC-141A StarLifter (61-2775) belonging to the Air Force Flight Test Center's 418th Flight Test Squadron. The mechanism used to pull the QF-106A (designated EXD-1 during these tests, for Experimental Demonstrator) was a synthetic rope made of Vectran attached to a breakable link which, for safety reasons, was designed to snap if too much stress was placed on it. Nylon straps were attached, which were designed to help the spring tendencies of the link. The actual tow exercise was preceded by a test flight in which a NASA F/A-18 Hornet flew at various distances and angles behind the NC-141A to determine turbulence and collect wingtip vortex data. A similar flight followed with an unmodified QF-106A in July 1997.

The first towed flight in the Eclipse tests was made on 20 December 1997 and the tests continued until the final one on 6 February 1998, when the towed 'Six' (59-0130) was taken to an altitude of 24,684 ft (7524 m) with pilot Mark Stucky on board. (Kelly Space Technologies plans eventually to use a Boeing 747 to tow an RLV called the Astroliner to 45,000 ft/13176 m, where the Astroliner will ignite its rocket engine and achieve escape velocity, permitting a flight into orbit.) This marked the last time a Convair F-106 Delta Dart was flown for any reason than to enter retirement at the 'boneyard'. On 1 May 1998 this last flying F-106 made its final flight – from Edwards to the AMARC – and Mark Stucky made a few farewell passes over the base prior to going on his way. The NC-141A was also retired from service following the Eclipse tests.

As for the aircraft themselves, in 1998 there are 10 in museum collections and at least 21 in storage at Davis-Monthan. Many of the AMARC aircraft will probably be offered to museums, but there is a chance a civilian contractor might find a use for some. As a potential warbird, the F-106 offers fewer challenges than the English Electric Lightning, which now has provisional approval to fly in the US, but whether any operator has the enthusiasm (or money) to campaign a 'Six' on the warbird circuit is not known. If the story ends in 1998 with Project Eclipse, it is fitting that the 'ultimate interceptor', the 'plane with a brain' should crown its career by helping the next generation of spacecraft reach even higher. **Robert F. Dorr**

Above: The last (to date) and perhaps most extraordinary use of the F-106 has been as a demonstrator for the Eclipse Astroliner delta-winged reusable satellite launch platform. To validate the concept of towing a delta-winged platform to high altitudes, an ex-5th FIS QF-106 was modified for towing behind a Lockheed StarLifter at Edwards AFB. After eight towed flights in 1997/98, the two aircraft involved were flown to AMARC for storage and an unknown fate.

Above left: A second QF-106A (59-0010, also ex-5th FIS) was used by NASA Dryden as a back-up for the Eclipse project and as a crew proficiency trainer. It is seen in the hangar at Dryden a few days before it was flown for the last time – to AMARC.

Below: The last Delta Dart has now fallen silent, probably for the final time. The company that made it merged into one that no longer makes aircraft, and the fighter interceptor squadrons, too, are but a memory. Although it never fought an enemy aircraft and was built in the smallest numbers of any of the 'Century Series' fighters, the F-106 will always be remembered by pilots and enthusiasts alike as the 'ultimate interceptor'.

Left: The J85 pods fitted beneath the wings of NASA 616 are clearly visible in this view of the aircraft.

Right: B model 59-0158 provides the background for this portrait of the seven Mercury astronauts: (from left) Carpenter, Cooper, Glenn, Grissom, Schirra, Shepard and Slayton.

NASA's Dart test fleet

Though not as easily recognised as a NASA workhorse as its other 'Century Series' stablemate, the F-104, the Convair F-106 did indeed serve at most NASA centres in a wide variety of tasks – astronaut trainer, SST testbed, environmental programmes and space launch concepts, to name a few.

Astronaut Trainers

In the autumn of 1958 the Space Task Group (STG) was established at NASA Langley to implement the Project Mercury manned space flight programme. A small fleet of flight proficiency aircraft was assigned to the STG, initially consisting of USAF-loaned T-33s, two F-102A and two TF-102A. In 1961, F-106A 58-0782 and F-106B 59-0158 arrived at Langley. When the STG was renamed the Manned Spacecraft Center and moved to Houston in early 1962, these aircraft were relocated to nearby Ellington AFB, and the nucleus of NASA's future independent astronaut training fleet was formed. Astronauts would later fly F-106 chase missions from Patrick AFB, Florida in support of Mercury space launches at nearby Cape Canaveral.

Shortly thereafter, the USAF began formulating an astronaut training programme of its own. In July 1963 the Aerospace Research Pilots School (ARPS) at Edwards AFB, California modified its curriculum to increase its pool of candidates eligible for astronaut training on future NASA and military space programmes such as the X-15, X-20 Dyna-Soar and the all-USAF Gemini (later renamed the Manned Orbiting Lab). A number of dedicated aircraft were thus added, including one JF-106A (57-0238) to study variable lift-drag ratios (written-off, 6 Dec 1965), and two F-106Bs (57-2519 and 57-2529) to investigate variable stability. In 1968 X-24 side-stick controllers were added to the F-106Bs by Martin Aircraft but technical problems plagued the programme and little flying was done in this capacity. They were finally retired in October 1971.

NASA Ames F-106A 57-0235

In the 1950s the NACA (later NASA) Ames Flight Research Branch, at Moffett Field, was conducting work on automatic control systems for aircraft; a fairly large part of this effort involving the optimisation of missile guidance systems, computing gunsights for fighters and semi-automatic missile fire-control systems for interceptors. Between September 1958 and December 1959, F-106A 57-0235 arrived at Ames for MA-1 fire control system and autopilot manoeuvre intercept tests, often using a B-47 or Douglas F5D-1 as targets.

NASA Lewis NF-106B 57-2516/NASA 616

The most distinguished Delta Dart, F-106B 57-2516, spent its entire career as a test vehicle for a series of important USAF and NASA research projects. It was completed on 4 September 1958 and delivered to NASA's Lewis Research Center, Cleveland, Ohio on 31 October 1966, and registered NASA 616. On 31 May 1967 it was redesignated NF-106B, and finally withdrawn from the USAF inventory on 27 February 1970.

As part of a broad research effort in air-breathing propulsion, and in support of the US Supersonic Transport Program, the Lewis Research Center had begun studies in the mid-1960s on the effects of airframe flow on the performance of propulsion systems in the high subsonic and supersonic flight regimes. In order to further study installation effects in this flight envelope, as well as noise suppression in engine inlet and nozzle configurations, F-106B 57-2516 was acquired and modified to serve as a testbed. The F-106B was an ideal choice, since its delta wing planform was representative of those proposed for SSTs, and its excellent performance, high load-carrying capacity, and provision for a second crew member allowed monitoring and operation of test installations.

The most notable modification made to NASA 616 was the installation of two underwing nacelles, each housing a J85-GE-13 afterburning turbojet which served as the gas generator for the test inlets and nozzles.

The first flight of NASA 616 modified for propulsion system research took place on 3 June 1968, in a programme that encompassed over 300 flights and tested numerous inlet and nozzle configurations. Flights were made from Cleveland Hopkins Airport or Selfridge ANGB, Michigan using test corridors over Lake Erie or Lake Huron.

Chase support for this programme was provided by F-8A 141354/NASA 666. After it was lost in July 1969, it was replaced by F-102A 56-998/NASA 617 in June 1970 and, in September 1972, by NF-106B NASA 607 (see separate entry below).

At the conclusion of this programme at Lewis, NASA 616 was turned over to the NASA Dryden Flight Research Center and redesignated NASA 816. Research needs, however, resulted in it being transferred directly to the NASA Langley Research Center, Virginia on 29 January 1979.

Above: NF-106B NASA 816 is seen here with the vortex flaps installed during the late 1980s.

Below: This remarkable photograph shows NASA 816, in its later guise as a storm research airframe, experiencing one of the over 700 lightning strikes on the aircraft.

NASA Lewis NF-106B 57-2507/NASA 607

On 26 September 1972, a second NF-106B (NASA 607) was added to the Lewis fleet, initially to provide chase support for NASA 616, but also used to support a number of other research programmes. Much of its USAF career had been spent as an ejection seat test aircraft with the AFFTC. Its first association with NASA was in connection with the final qualification tests for the Gemini spacesuit and spacecraft escape system designed by Weber. Following a static compatibility test on 15 October 1964, a subsonic ejection was conducted at El Centro on 12 January 1965 at Mach 0.65 and 15,700 ft (4785 m) altitude. Two weeks later a supersonic ejection was conducted at Mach 1.72 and 40,000 ft (12192 m), thus clearing the seat for the first manned Gemini mission on 23 March 1965.

At Lewis, NASA 607 was assigned to chase duties in support of the NF-106B SST testbed, NASA 616. It proved to be a versatile platform for a number of other research programmes, also, flown intermittently in this capacity until its transfer to Langley on 12 May 1981.

Starting in October 1974, NASA 607 took over a solar cell calibration task from Lewis's B-57B NASA 237 and later, as part of the Global Air Sampling Program (GASP), 607 was fitted with air sampling pods on each wing pylon. Between April and May 1977, NASA 607 was deployed for a 10-day GASP mission to Elmendorf AFB, Alaska. The last notable mission was flown to gather volcanic aerosols and ash in the wake of the eruption of Mount St Helens on 18 May 1980.

Under a separate environmental study, an ocean colour scanner was mounted on a wing pylon and used to monitor water quality and pollution levels in the Great Lakes and Lake Okeechobee, Florida (operating out of Patrick AFB). These missions were flown at altitudes below 1,000 ft (305 m). A test observer in the back seat gathered data for later correlation with samples taken from a surface vessel. At the end of its usefulness at Lewis, NASA 607 unfortunately met with a different fate as NASA 816. It was transferred to NASA Langley on 12 May 1981, where it was unceremoniously cut in half lengthways (as the 'F-53') and used in wind-tunnel tests.

NASA Langley NF-106B 57-2516/NASA 816

Following its arrival from Lewis on 29 January 1979, NF-106B NASA 816 was readied for the first of two major research programmes at Langley – Storm Hazards Research and Vortex Flap Research. F-106A 59-123 arrived at Langley on 19 March 1982 to provide spares for 816.

Storm Hazards Research 1979-1986: With the increased use of composite materials in aircraft construction, digital avionics, and electronic flight control systems came increased concerns over lightning protection for such features. To address these issues, NASA Langley initiated the Storm Hazards Research programme, for which NF-106B NASA 816 was prepared and 'hardened' against the effects of lightning. The majority of thunderstorm research flights were conducted in the vicinity of NASA Langley and the NASA Wallops Island Flight Facility, Virginia. Initial research flights in 1980 and 1981 were made in the vicinity of the National Oceans and Atmospheric Administration (NOAA) National Severe Storms Laboratory, Norman, Oklahoma.

During 195 Storm Hazards research flights, NASA 816 made 1,496 thunderstorm penetrations at altitudes ranging from 5,000-50,000 ft (1524-15240 m) and experienced 714 direct lightning strikes. The airborne data that was gathered provided the first verification that aircraft frequently trigger their own lightning strikes.

During the course of the Storm Hazards Program, NASA and the USAF Weapons Lab at Kirtland AFB, New Mexico conducted joint tests to compare the electromagnetic effects of lightning with those generated by nuclear detonations. A simulated electromagnetic pulse (EMP) test was conducted between January and March 1984 by mounting NASA 816 on a special dielectric test stand.

Vortex Flap Flight Experiment 1986-1991: Aircraft designed to cruise efficiently at supersonic speeds usually employ highly swept wings with relatively sharp leading edges which, under certain off-design conditions, produce strong vortices over the upper surfaces which increase lift but also increase drag. A special flap was developed at Langley to entrain the vortex spanways along the leading edge, thereby resulting in a significant improvement in lift-to-drag ratio. Verification of performance improvements provided by this 'vortex flap' required flight testing. Because its highly swept wing was representative of those that might employ a vortex flap, the F-106B was selected as the test vehicle.

Having just completed the Storm Hazards Program, NASA 816 was readied for this experiment and received modifications to evaluate a sharp, leading-edge vortex flap by gathering wing surface pressure distributions and flow visualisation data. Flight tests of the unmodified NF-106B were conducted in 1987 to establish a performance baseline. The wing leading edges were then removed and replaced with new leading edges incorporating ground-adjustable vortex flaps. The right wing was instrumented with pressure straps to measure surface pressures; the left wing was instrumented with accelerometers and strain gauges to monitor structural loads and deformations.

The first flight with the vortex flap took place on 2 August 1988. In all, 93 flights were conducted over the next two-and-a-half years, after which NASA 816 was ceremoniously retired on 17 May 1991 and the last manned F-106 passed from active service, except for a handful of QF-106s which continued to fly as target drones. NASA 816 was placed on permanent display along with other historic NASA and USAF aircraft in the Virginia Air and Space Center/Hampton Roads History Center.

NASA Dryden QF-106A/EXD-01 59-0130

In 1996 the NASA Dryden Flight Research Center began hosting Project Eclipse in support of a joint Kelly Space & Technology, Inc. (KST) and USAF project to tow in flight a modified F-106 using a C-141A. Data gathered would demonstrate the viability of towing delta-wing aircraft with high wing loading, validate simulation models, and develop operational and abort procedures. KST would use this data to develop its Eclipse family of low-cost, reusable tow-launch space vehicles.

The F-106 was an ideal candidate since its delta wing planform was representative of the Eclipse vehicles. Two aircraft were bailed from the USAF 475th WEG target drone inventory and delivered to NASA Dryden in the spring of 1997. QF-106 59-0130 was modified into the Eclipse eXperimental Demonstrator-01 by KST, and a second aircraft, 59-0010, served as a back-up and pilot proficiency aircraft.

Wake turbulence assessments and air data calibrations were conducted between the QF-106 and NC-141 between October 1996 and July 1997 as a prelude to the tow tests. On 20 December 1997 the two aircraft were staged on the Edwards runway and were prepared for their first tethered test flight. As a flight safety contingency, NASA Dryden research pilot Mark Stucky idled the J75 to 60 per cent thrust to facilitate rapid spool-up to full power if the need arose for a breakaway manoeuvre.

The tow train accelerated down the runway and, at 120 kt (138 mph; 222 km/h) airspeed, the StarLifter rotated and levelled off at 300 ft (91 m) to ensure that the QF-106 in tow stayed clear of any wake turbulence. Thirty seconds later Stucky rotated and took-off at 170 kt (195 mph; 315 km/h) for a smooth and uneventful climb to 10,000 ft (3048 m). Removal of the clamshell cargo doors on the C-141 imposed a tow speed limit of 200 kt (230 mph; 370 km/h). Throughout the flight, Stucky flew in a high-drag configuration with landing gear and speed brakes extended while maintaining a 'low tow' position at -20° elevation angle. A series of manoeuvres into the C-141 wake and vortex field was conducted and tow rope dynamics were investigated. The tow flight was concluded when Stucky released the rope, completed engine power-up and conducted an off-tow manoeuvre to clear the rope. The 18-minute test flight concluded with a normal landing at Edwards AFB. Three more tests were conducted on 21, 23 and 28 January 1998 and on 5 and 6 February, respectively, the two QF-106s were flown into storage at AMARC, ending NASA's nearly 40-year association with the type.

Terry Panopalis

F-106 PRODUCTION

Here the USAF serial numbers, production line numbers, delivery dates and ultimate fates of all 340 F-106s are listed. Those aircraft marked '§' were still present at AMARC in early June 1998.

F-106As

56-0451	1	Dec 56	23 Mar 60	displayed, Selfridge AFB Museum (as '59-0082')
56-0452	2	Feb 57		not accepted by ADC; ground trainer, Amarillo AFB
n/a	n/a	Sep 57	?	? (static test airframe)
56-0453	3	Aug 57	27 Jan 95	to QF-106 (AD111); crashed, Holloman AFB
56-0454	11	Nov 57	4 Jun 96	QF-106 (AD102); cannibalised for parts, Holloman AFB
56-0455	4	Nov 57	16 May 67	written-off AFSC
56-0456	5	Oct 57	14 Jun 65	crashed on take-off 498th FIS
56-0457	14	Apr 58	13 Nov 91	QF-106 (AD116); shot down with AIM-7M, Tyndall AFB
56-0458	6	Nov 57	6 Sep 95	QF-106 (AD230); shot down with AIM-9M, Tyndall AFB
56-0459	7	Dec 57	?	displayed, McChord AFB
56-0460	8	Jan 58	?	displayed, Minot AFB
56-0461	9	Jan 58	2 Apr 85	AMARC§
56-0462	10	Mar 58	6 Jun 75	crashed 48th FIS
56-0463	12	Apr 58	21 Nov 95	QF-106 (AD235); shot down with 'ADP-1020', Holloman AFB
56-0464	15	Apr 58	4 Aug 64	crashed 318th FIS
56-0465	16	May 58	9 Nov 92	QF-106 (AD149); shot down with AIM-120, Holloman AFB
56-0466	17	May 58	12 Feb 97	QF-106 (AD247); shot down with AIM-120, Tyndall AFB
56-0467	18	Apr 58	14 Aug 61	crashed 329th FIS
57-0229	19	Jun 58	8 Apr 59	crashed AFSC
57-0230	20	May 58	1 Feb 85	written-off 87th FIS; displayed, Homestead AFB
57-0231	22	May 58	28 May 81	crashed 87th FIS
57-0232	23	May 58	12 Jun 92	QF-106 (AD151); crashed, Holloman AFB
57-0233	25	Jun 58	12 Apr 63	(Matador SSM kill, 1960); written-off 94th FIS.
57-0234	26	Jun 58	25 Oct 95	QF-106 (AD175); shot down with AIM-120, Tyndall AFB
57-0235	28	Jul 58	16 Nov 94	QF-106 (AD239); shot down with AIM-7M, Tyndall AFB
57-0236	30	Jul 58	29 Jan 97	QF-106 (AD248); shot down with AIM-120, Tyndall AFB
57-0237	32	Aug 58	8 May 74	crashed 5th FIS
57-0238	34	Aug 58	6 Dec 65	never assigned to ADC; crashed AFFTC
57-0239	36	Nov 58	4 Apr 60	YF-106C; destroyed in fatigue testing
57-0240	38	Dec 58	2 Dec 93	YF-106C; later QF-106 (AD251); shot down with AIM-9P, Tyndall AFB
57-0241	40	Oct 58	8 May 96	QF-106 (AD240); shot down with AIM-120, Tyndall AFB
57-0242	42	Nov 58	27 Oct 58	crashed AFFTC (Convair aircraft)
57-0243	43	Nov 58	10 Mar 93	QF-106 (AD114); shot down with AIM-7M, Tyndall AFB
57-0244	44	Nov 58	25 Apr 95	QF-106 (AD232); crash landing, Tyndall AFB
57-0245	45	Nov 58	17 Oct 91	QF-106 (AD117); shot down with AIM-120, Tyndall AFB
57-0246	46	Jan 59	29 Jun 93	QF-106 (AD161); ran off droneway, Tyndall AFB
57-2453	47	Feb 59	12 Dec 96	QF-106 (AD198); shot down with Patriot, Holloman AFB
57-2454	48	Feb 59	26 Jul 64	crashed 539th FIS
57-2455	49	Feb 59	2 Jun 93	QF-106 (AD214); shot down with AIM-7M, Tyndall AFB
57-2456	51	Mar 59	21 Jul 94	QF-106 (AD189); shot down with AIM-7M, Tyndall AFB
57-2457	52	Mar 59	22 Apr 69	crashed 460th FIS
57-2458	54	Mar 59	3 Sep 79	crashed 186th FIS
57-2459	55	Apr 59	4 Jun 96	QF-106 (AD103); cannibalised for spares, Holloman AFB
57-2460	56	Apr 59	9 Jun 79	crashed 186th FIS
57-2461	58	Apr 59	17 Apr 96	QF-106 (AD190); shot down with AIM-120, Tyndall AFB
57-2462	59	Apr 59	21 Dec 61	crashed 498th FIS
57-2463	61	Apr 59	6 May 94	QF-106 (AD193); crash landing, Tyndall AFB
57-2464	62	Apr 59	30 Jun 84	destroyed 186th FIS
57-2465	64	Jun 59	9 Jan 98	prototype ARDC instrument test aircraft; QF-106 (AD132); command destroyed, Tyndall AFB
57-2466	66	Apr 59	26 May 94	QF-106 (AD210); shot down with AIM-120, Holloman AFB
57-2467	67	May 59	9 Aug 96	QF-106 (AD209); shot down with ? (Army), Holloman AFB
57-2468	68	May 59	20 Jul 64	destroyed by fire 539th FIS
57-2469	70	May 59	7 Dec 67	crashed 456th FIS
57-2470	71	May 59	1 Feb 94	QF-106 (AD206); shot down with AIM-120, Holloman AFB
57-2471	72	May 59	4 May 65	destroyed in mid-air collision (57-2828) 539th FIS
57-2472	74	May 59	19 Jun 69	crashed 95th FIS
57-2473	75	May 59	6 Jun 83	crashed 101st FIS
57-2474	76	Jun 59	9 Jun 61	crashed 539th FIS
57-2475	78	Jun 59	9 Oct 96	QF-106 (AD203); control lost/command destroyed, Holloman AFB
57-2476	79	Jun 59	14 Sep 93	QF-106 (AD196); shot down with AIM-120, Tyndall AFB
57-2477	80	Jun 59	24 Apr 96	QF-106 (AD212); shot down with 20-mm fire, Tyndall AFB

F-106A 59-0047 was flown 'hands-off' between Palmdale and Jacksonville on 30 March 1960, using its Hughes MA-1 navigation/fire control system. Here it is seen, some years later, in the markings of the 95th FIS.

59-0043 was not only the ANG's last serving F-106, but went on to be one of the last two QF-106s. It was flown to AMARC in March 1998.

57-2478	81	Jun 59	22 Jun 95	QF-106 (AD195); shot down with AIM-120, Holloman AFB
57-2479	83	Jun 59	4 Feb 63	crashed 498th FIS
57-2480	84	Jun 59	2 Sep 94	QF-106 (AD211); shot down with AIM-120, Tyndall AFB
57-2481	85	Jun 59	25 Jul 95	QF-106 (AD185); shot down with AIM-120, Tyndall AFB
57-2482	86	Jul 59	20 Aug 96	QF-106 (AD191); shot down with AIM-7M, Tyndall AFB
57-2483	87	Jul 59	18 Dec 92	QF-106 (AD197); shot down with AIM-120, Tyndall AFB
57-2484	89	Jul 59	14 Sep 61	crashed 498th FIS
57-2485	90	Jul 59	26 Apr 93	QF-106 (AD192); written-off (broken wing spar), Tyndall AFB.
57-2486	91	Jul 59	14 Dec 72	crashed 186th FIS
57-2487	92	Jul 59	1 Mar 96	QF-106 (AD188); shot down with AIM-7M, Tyndall AFB
57-2488	93	Jul 59	10 Mar 61	destroyed 498th FIS
57-2489	94	Jul 59	19 Mar 63	crashed 456th FIS
57-2490	96	Jul 59	19 May 63	QF-106 (AD163); shot down with AIM-120, Tyndall AFB
57-2491	97	Jul 59	11 Jul 73	crashed 186th FIS
57-2492	98	Jul 59	20 Aug 97	QF-106 (AD199); shot down with AIM-120, Tyndall AFB
57-2493	99	Jul 59	10 Nov 94	QF-106 (AD208); shot down with 'ADP-1020', Holloman AFB
57-2494	100	Jul 59	27 Aug 96	QF-106 (AD200); shot down with Stinger, Holloman AFB
57-2495	101	Jul 59	2 Aug 94	QF-106 (AD165); crashed on take-off, Tyndall AFB
57-2496	103	Aug 59	8 May 96	QF-106 (AD186); inadvertently destroyed over range, Tyndall AFB
57-2497	104	Aug 59	21 Jan 93	QF-106 (AD194); shot down with AIM-120, Tyndall AFB
57-2498	105	Aug 59	5 May 64	crashed 95th FIS
57-2499	106	Aug 59	10 Jan 95	QF-106 (AD202); shot down with 'ADP-1020', Holloman AFB
57-2500	107	Aug 59	8 Jan 70	crashed 95th FIS (Osan AB)
57-2501	108	Aug 59	14 Aug 96	QF-106 (AD253); shot down with AIM-7M, Tyndall AFB
57-2502	110	Aug 59	29 Sep 70	Convair San Diego from 95th FIS; written-off in fatigue testing
57-2503	111	Aug 59	2 Apr 97	QF-106 (AD213); shot down with AIM-120, Tyndall AFB
57-2504	112	Aug 59	12 Aug 96	QF-106 (AD205); shot down with ? (Army), Holloman AFB
57-2505	113	Aug 59	28 Jul 93	QF-106 (AD204); shot down with AIM-7M, Tyndall AFB
57-2506	114	Aug 59	2 Aug 93	QF-106 (AD207); command destroyed (fatigue cracks), Tyndall AFB
58-0759	115	Aug 59	11 Apr 67	crashed 71st FIS
58-0760	117	Aug 59	2 Mar 93	QF-106 (AD136); shot down with AIM-7M, Tyndall AFB
58-0761	118	Aug 59	9 Jan 63	destroyed by fire 71st FIS
58-0762	119	Sep 59	30 Sep 59	crashed before delivery
58-0763	120	Sep 59	8 Jan 63	destroyed by fire 71st FIS
58-0764	121	Sep 59	19 Sep 94	QF-106 (AD179); shot down with AIM-120, Tyndall AFB
58-0765	122	Sep 59	18 Jan 71	crashed 48th FIS
58-0766	124	Sep 59	1 Feb 94	QF-106 (AD129); shot down with AIM-120, Tyndall AFB
58-0767	125	Sep 59	26 Aug 94	QF-106 (AD229); went out of control and crashed, Tyndall AFB
58-0768	126	Sep 59	2 Sep 69	crashed 94th FIS
58-0769	127	Sep 59	10 Mar 66	crashed after mid-air collision (T-33) 318th FIS
58-0770	128	Sep 59	9 Jan 61	crashed 71st FIS
58-0771	129	Sep 59	8 Jan 62	destroyed 71st FIS
58-0772	131	Sep 59	26 Sep 91	QF-106 (AD120); shot down with AIM-7M, Tyndall AFB
58-0773	132	Sep 59	13 Dec 95	QF-106 (AD234); shot down with 'ADP-1020', Holloman AFB
58-0774	133	Sep 59	4 Mar 98	QF-106 (AD146); AMARC§ after making last QF flight, Tyndall AFB
58-0775	134	Sep 59	20 Oct 92	QF-106 (AD138); shot down with AIM-120, Holloman AFB
58-0776	135	Oct 59	29 Aug 80	crashed 318th FIS
58-0777	136	Oct 59	18 Jul 79	crashed 194th FIS
58-0778	138	Oct 59	9 Jul 81	crashed ADWC
58-0779	139	Oct 59	9 Jan 98	QF-106 (AD141); shot down with AIM-9M, Tyndall AFB
58-0780	140	Oct 59	9 Mar 93	QF-106 (AD166); shot down with AIM-7M, Holloman AFB
58-0781	141	Oct 59	5 Apr 77	crashed 159th FIS
58-0782	142	Oct 59	13 Jul 93	QF-106 (AD147); shot down with AIM-120, Tyndall AFB
58-0783	143	Oct 59	21 Feb 92	QF-106 (AD108); shot down with AIM-120, Tyndall AFB
58-0784	145	Oct 59	3 Oct 86	crashed 159th FIS
58-0785	146	Oct 59	7 Feb 77	crashed 159th FIS
58-0786	147	Oct 59	25 Sep 97	QF-106 (AD154); written-off (cracked wing spar), Tyndall AFB
58-0787	148	Oct 59	15 Aug 86	to USAF Museum
58-0788	149	Oct 59	24 Sep 92	QF-106 (AD150); shot down with Patriot, Holloman AFB
58-0789	151	Oct 59	17 Mar 66	crashed 27th FIS
58-0790	152	Oct 59	30 Nov 93	QF-106 (AD228); ran off runway, Tyndall AFB
58-0791	153	Nov 59	10 Dec 97	QF-106 (AD121); shot down with AIM-120, Tyndall AFB
58-0792	154	Nov 59	26 Aug 93	QF-106 (AD153); command destroyed after lightning strike and flame out, Tyndall AFB
58-0793	155	Nov 59	23 Feb 98	QF-106 (AD242); AMARC§
58-0794	156	Nov 59	4 Nov 64	crashed 94th FIS
58-0795	158	Nov 59	11 May 94	QF-106 (AD180); shot down with AIM-7M, Tyndall AFB
58-0796	159	Nov 59	13 Aug 61	written-off 94th FIS
58-0797	160	Nov 59	20 Feb 90	QF-106 (AD104); shot down with AIM-7F, Tyndall AFB
58-0798	161	Nov 59	13 Jun 66	crashed 94th FIS
59-0001	162	Nov 59	12 Oct 66	crashed 5th FIS
59-0002	163	Nov 59	27 Mar 92	QF-106 (AD113); shot down with AIM-7M, Tyndall AFB
59-0003	165	Nov 59	24 Jan 85	AMARC; later Pima Air and Space Museum
59-0004	166	Nov 59	24 Jun 80	crashed 318th FIS
59-0005	167	Nov 59	8 Jun 95	QF-106 (AD238); shot down with AIM-120, Tyndall AFB

F-106 Delta Dart

The trailing aircraft of this pair of 5th FIS F-106As, 59-0130, later served as one of the Project Eclipse aircraft, finally arriving at AMARC on 1 May 1998 as the last active 'Six'.

59-0006	168	Dec 59	9 Sep 91	QF-106 (AD110); shot down with AIM-120, Tyndall AFB
59-0007	170	Dec 59	5 Sep 97	QF-106 (AD215); shot down with 20-mm fire, Tyndall AFB
59-0008	171	Dec 59	5 Nov 96	QF-106 (AD167); shot down with AIM-120, Tyndall AFB
59-0009	172	Dec 59	13 Feb 78	crashed ADWC
59-0010	173	Dec 59	2 Aug 96	QF-106 (AD246) stored; 15 Jul 97 to NASA (Project Eclipse) 30 Apr 98 to AMARC§
59-0011	175	Dec 59	19 Sep 96	QF-106 (AD159); command destroyed after landing gear malfunction, Tyndall AFB
59-0012	176	Dec 59	3 Apr 85	AMARC§
59-0013	177	Dec 59	3 Oct 63	crashed 5th FIS
59-0014	178	Dec 59	10 Mar 69	crashed 5th FIS
59-0015	180	Dec 59	5 Mar 92	QF-106 (AD115); crashed on take-off, Tyndall AFB
59-0016	181	Dec 59	21 Nov 97	QF-106 (AD244); shot down with AIM-120, Tyndall AFB
59-0017	182	Dec 59	19 Dec 63	crashed 5th FIS
59-0018	183	Dec 59	16 Sep 74	destroyed in mid-air collision (59-0030) 5th FIS
59-0019	184	Jan 60	2 Dec 76	crashed 5th FIS
59-0020	185	Jan 60	15 Aug 95	QF-106 (AD172); shot down with AIM-120, Tyndall AFB
59-0021	186	Jan 60	15 May 73	crashed after lightning strike 49th FIS
59-0022	187	Jan 60	3 Oct 67	crashed 318th FIS
59-0023	188	Jan 60	20 Feb 98	QF-106 (AD218); Dover AFB for display
59-0024	190	Jan 60	10 Nov 93	QF-106 (AD182); shot down with AIM-120, Tyndall AFB
59-0025	191	Jan 60	8 Feb 94	QF-106 (AD233); crashed on landing, Tyndall AFB
59-0026	192	Jan 60	7 Sep 93	QF-106 (AD139); shot down with AIM-7M, Tyndall AFB
59-0027	193	Jan 60	1 Dec 94	QF-106 (AD183); crashed on take-off, Tyndall AFB
59-0028	194	Jan 60	19 Mar 74	crashed 49th FIS
59-0029	195	Jan 60	28 Jul 61	crashed 319th FIS
59-0030	196	Jan 60	16 Sep 74	destroyed in mid-air collision (59-0018) 5th FIS
59-0031	197	Jan 60	17 Jan 96	QF-106 (AD221); shot down with AIM-7M, Tyndall AFB
59-0032	198	Jan 60	11 Oct 94	QF-106 (AD231); shot down with 'ADP-1020', Holloman AFB
59-0033	199	Feb 60	19 Sep 94	QF-106 (AD220); shot down with AIM-120, Tyndall AFB
59-0034	200	Feb 60	8 Nov 96	QF-106 (AD223); shot down with Stinger, Holloman AFB
59-0035	202	Feb 60	1 Sep 92	QF-106 (AD124); shot down with AIM-7M, Tyndall AFB
59-0036	203	Feb 60	9 Jun 70	crashed 27th FIS
59-0037	204	Feb 60	17 Dec 93	QF-106 (AD243); shot down with AIM-120, Tyndall AFB
59-0038	205	Feb 60	10 Dec 93	QF-106 (AD171); shot down with AIM-120, Tyndall AFB
59-0039	206	Feb 60	8 Oct 63	crashed 27th FIS
59-0040	208	Feb 60	28 Feb 97	QF-106 (AD225); shot down with AIM-120, Tyndall AFB
59-0041	209	Feb 60	7 Sep 65	crashed 27th FIS
59-0042	210	Feb 60	15 Sep 92	QF-106 (AD122); shot down with AIM-9M, Tyndall AFB
59-0043	211	Feb 60	4 Mar 98	QF-106 (AD227); made last QF-106 flight (with 58-0774); later AMARC§
59-0044	212	Feb 60	27 Sep 94	QF-106 (AD226); crashed on landing, Tyndall AFB
59-0045	214	Feb 60	7 Jun 61	crashed 27th FIS
59-0046	215	Feb 60	10 Oct 96	QF-106 (AD224); shot down with Stinger, Holloman AFB
59-0047	216	Mar 60	23 Feb 98	QF-106 (AD219); written-off (cracked wing spar), Tyndall AFB
59-0048	217	Mar 60	5 Nov 96	QF-106 (AD217); crashed on landing, Tyndall AFB
59-0049	218	Mar 60	18 Apr 95	QF-106 (AD222); shot down with AIM-120, Tyndall AFB
59-0050	220	Mar 60	8 Apr 64	crashed 318th FIS
59-0051	221	Mar 60	28 Jan 98	QF-106 (AD255); shot down on last QF-106 mission with AIM-9M, Tyndall AFB
59-0052	222	Mar 60	11 Dec 73	crashed 84th FIS
59-0053	223	Mar 60	18 May 94	QF-106 (AD173); shot down with AIM-7M, Tyndall AFB
59-0054	224	Mar 60	14 Feb 96	QF-106 (AD201); shot down with AIM-120, Tyndall AFB
59-0055	226	Mar 60	30 Nov 65	destroyed by fire 318th FIS
59-0056	227	Mar 60	7 Jul 93	QF-106 (AD164); shot down with AIM-120, Tyndall AFB
59-0057	228	Mar 60	9 Apr 96	QF-106 (AD176); shot down with AIM-120, Tyndall AFB
59-0058	229	Mar 60	20 Jul 95	QF-106 (AD184); ran off droneway, Tyndall AFB
59-0059	230	Mar 60	6 Jul 90	QF-106 (AD105); crashed, Tyndall AFB
59-0060	232	Mar 60	16 Jun 95	QF-106 (AD127); shot down with AIM-120, Tyndall AFB
59-0061	233	Mar 60	3 Sep 93	QF-106 (AD156); shot down with AIM-9M, Tyndall AFB
59-0062	234	Apr 60	12 Nov 93	QF-106 (AD168); shot down with AIM-120, Tyndall AFB
59-0063	235	Apr 60	12 Feb 93	QF-106 (AD118); shot down with AIM-120, Tyndall AFB
59-0064	236	Apr 60	16 Jun 93	QF-106 (AD155); shot down with AIM-120, Tyndall AFB
59-0065	238	Apr 60	25 Feb 92	AMARC§
59-0066	239	Apr 60	22 Sep 95	QF-106 (AD187); shot down with AIM-120, Tyndall AFB
59-0067	240	Apr 60	20 Feb 73	crashed 49th FIS
59-0068	241	Apr 60	13 Sep 67	destroyed by fire 438th FIS
59-0069	242	Apr 60	?	displayed, Griffiss AFB
59-0070	244	Apr 60	22 Sep 61	'total loss' (crash?) 438th FIS
59-0071	245	Apr 60	4 Jun 81	crashed 49th FIS
59-0072	246	Apr 60	4 May 94	QF-106 (AD123); shot down with 'Brite Eye', Holloman AFB
59-0073	247	Apr 60	19 Nov 60	crashed 438th FIS
59-0074	248	Apr 60	2 Feb 93	QF-106 (AD133); shot down with AIM-7M, Tyndall AFB
59-0075	250	May 60	22 Aug 75	crashed 49th FIS
59-0076	251	May 60	12 Nov 93	QF-106 (AD169); control lost/command destroyed
59-0077	252	May 60	2 Jul 93	QF-106 (AD140); shot down with AIM-7M, Tyndall AFB
59-0078	253	May 60	27 Oct 78	crashed 49th FIS
59-0079	255	May 60	7 Jul 83	AMARC§
59-0080	256	May 60	8 Nov 81	QF-106 (AD126); shot down with AIM-9M, Tyndall AFB
59-0081	257	May 60	17 May 94	QF-106 (AD177); shot down with AIM-120, Tyndall AFB
59-0082	258	May 60	15 May 92	QF-106 (AD128); shot down with AIM-9M, Tyndall AFB
59-0083	260	May 60	18 May 93	QF-106 (AD143); shot down with AIM-120, Tyndall AFB
59-0084	261	May 60	25 Apr 73	crashed 49th FIS
59-0085	262	May 60	26 May 94	QF-106 (AD130); shot down with AIM-120, Holloman AFB
59-0086	263	May 60	4 Sep 85	AMARC§
59-0087	264	Jun 60	11 Oct 61	crashed 11th FIS
59-0088	266	Jun 60	5 Oct 72	crashed 87th FIS
59-0089	267	Jun 60	26 Nov 72	crashed 87th FIS
59-0090	268	Jun 60	3 Dec 87	QF-106 (AD254); shot down with AIM-7M, Tyndall AFB
59-0091	269	Jun 60	15 Jul 94	QF-106 (AD181); shot down with AIM-7M, Tyndall AFB
59-0092	270	Jun 60	22 Sep 92	QF-106 (AD112); shot down with AIM-7M, Tyndall AFB
59-0093	272	Jun 60	5 Jun 96	QF-106 (AD237); shot down with AIM-120, Tyndall AFB
59-0094	273	Jun 60	19 Sep 96	QF-106 (AD236); shot down with AIM-120, Tyndall AFB
59-0095	274	Jun 60	21 May 85	AMARC§
59-0096	275	Jun 60	20 May 94	QF-106 (AD160); shot down with AIM-120, Holloman AFB
59-0097	276	Jun 60	19 Nov 96	QF-106 (AD216); shot down with AIM-9M, Tyndall AFB
59-0098	278	Jun 60	19 Nov 62	crashed 11th FIS
59-0099	279	Jun 60	23 Apr 93	QF-106 (AD137); shot down with AIM-9M, Tyndall AFB
59-0100	280	Jul 60	1 Jul 94	QF-106 (AD174); shot down with AIM-120, Tyndall AFB
59-0101	281	Jul 60	18 Jul 79	crashed 87th FIS
59-0102	282	Jul 60	2 Jul 97	QF-106 (AD245); shot down with AIM-120, Tyndall AFB
59-0103	284	Jul 60	27 Nov 80	crashed ADWC
59-0104	285	Jul 60	5 Nov 93	QF-106 (AD142); shot down with AIM-120, Holloman AFB
59-0105	286	Jul 60	23 Feb 98	QF-106 (AD250); written-off (cracked wing spar), Tyndall AFB
59-0106	287	Jul 60	20 Dec 96	QF-106 (AD241); shot down with AIM-120, Tyndall AFB
59-0107	288	Jul 60	2 Jan 63	crashed 329th FIS
59-0108	290	Jul 60	4 Dec 97	QF-106 (AD249); shot down with AIM-120, Tyndall AFB
59-0109	291	Jul 60	19 Feb 92	QF-106 (AD148); shot down with AIM-120, Tyndall AFB
59-0110	292	Jul 60	19 Feb 93	QF-106 (AD125); shot down with AIM-120, Tyndall AFB

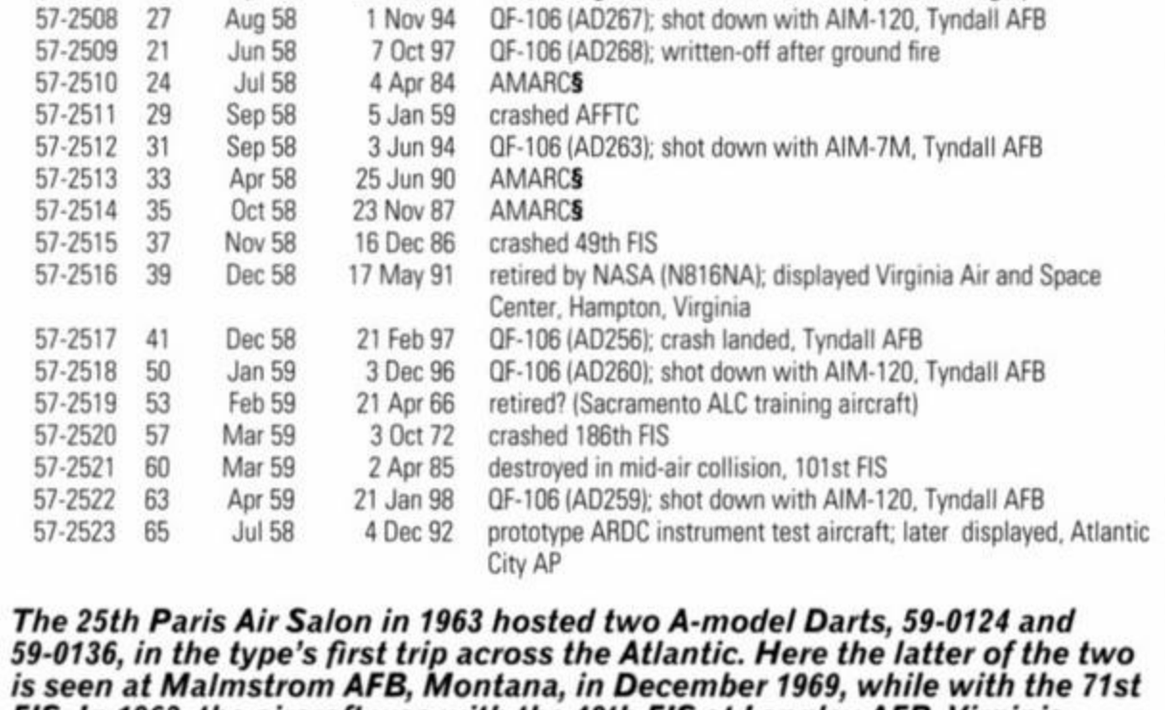
59-0165, the last B-model 'Six' off the line, became the personal mount of (and was accordingly named after) General 'Chappie' James, commander of Air Defense Command and CINCNORAD between 1 September 1975 and 6 December 1977.

59-0111	293	Aug 60	12 Oct 65	crashed 329th FIS
59-0112	294	Aug 60	9 Oct 73	crashed 48th FIS
59-0113	296	Aug 60	28 Jan 64	crashed 48th FIS
59-0114	297	Aug 60	4 Apr 63	crashed 48th FIS
59-0115	298	Aug 60	5 Mar 82	AMARC§
59-0116	299	Aug 60	12 Jan 82	AMARC
59-0117	301	Aug 60	3 Sep 63	crashed 498th FIS
59-0118	302	Aug 60	11 Jun 68	crashed ADWC
59-0119	303	Aug 60	13 Sep 91	QF-106 (AD106); shot down with AIM-120, Tyndall AFB
59-0120	304	Aug 60	14 Feb 61	crashed 329th FIS
59-0121	306	Aug 60	24 Apr 69	crashed 94th FIS
59-0122	307	Aug 60	25 Jan 82	AMARC
59-0123	308	Sep 60	9 Mar 83	NASA (for parts); later displayed, Warner Robins AFB
59-0124	309	Sep 60	9 Mar 64	crashed 48th FIS
59-0125	311	Sep 60	7 Nov 71	crashed 84th FIS
59-0126	312	Sep 60	13 Nov 96	QF-106 (AD158); broke-up in flight, Tyndall AFB
59-0127	313	Sep 60	25 Jun 92	QF-106 (AD131); shot down with AIM-9M, Tyndall AFB
59-0128	315	Sep 60	30 Apr 96	QF-106 (AD144); crashed over White Sands range, Holloman AFB
59-0129	316	Sep 60	30 Aug 94	QF-106 (AD162); written-off (T-tank ruptured), Tyndall AFB
59-0130	317	Sep 60	11 Sep 96	QF-106 (AD152) stored; 21 May 97 to NASA (Project Eclipse); 1 May 98 to AMARC§
59-0131	319	Sep 60	18 Oct 71	crashed 84th FIS
59-0132	320	Sep 60	21 Oct 92	QF-106 (AD135); shot down with Patriot, Holloman AFB
59-0133	321	Sep 60	8 Mar 94	QF-106 (AD252); crashed on take-off, Tyndall AFB
59-0134	323	Oct 60	2 Nov 95	displayed Peterson AFB
59-0135	324	Oct 60	12 Aug 93	QF-106 (AD170); control lost/command destroyed
59-0136	325	Oct 60	30 Mar 93	QF-106 (AD178); crashed, Tyndall AFB
59-0137	327	Oct 60	16 Oct 84	AMARC§
59-0138	328	Oct 60	11 Apr 95	QF-106 (AD157); crashed, Tyndall AFB
59-0139	329	Oct 60	17 May 61	crashed 456th FIS
59-0140	331	Oct 60	11 Jun 92	QF-106 (AD145); shot down with AIM-120, Tyndall AFB
59-0141	332	Oct 60	6 Nov 92	QF-106 (AD134); shot down with Stinger, Holloman AFB
59-0142	333	Oct 60	27 Aug 63	crashed 498th FIS
59-0143	335	Oct 60	24 Oct 84	crashed 49th FIS
59-0144	336	Oct 60	29 May 78	crashed 318th FIS
59-0145	337	Oct 60	?	displayed, Tyndall Air Park, Tyndall AFB
59-0146	338	Nov 60	?	displayed, Fresno Air Terminal, California
59-0147	339	Nov 60	17 Oct 83	AMARC§
59-0148	340	Nov 60	22 Apr 69	crashed 318th FIS

F-106Bs

57-2507	13	Apr 58	24 Feb 84	never assigned to ADC; written-off by NASA, Langley
57-2508	27	Aug 58	1 Nov 94	QF-106 (AD267); shot down with AIM-120, Tyndall AFB
57-2509	21	Jun 58	7 Oct 97	QF-106 (AD268); written-off after ground fire
57-2510	24	Jul 58	4 Apr 84	AMARC§
57-2511	29	Sep 58	5 Jan 59	crashed AFFTC
57-2512	31	Sep 58	3 Jun 94	QF-106 (AD263); shot down with AIM-7M, Tyndall AFB
57-2513	33	Apr 58	25 Jun 90	AMARC§
57-2514	35	Oct 58	23 Nov 87	AMARC§
57-2515	37	Nov 58	16 Dec 86	crashed 49th FIS
57-2516	39	Dec 58	17 May 91	retired by NASA (N816NA); displayed Virginia Air and Space Center, Hampton, Virginia
57-2517	41	Dec 58	21 Feb 97	QF-106 (AD256); crash landed, Tyndall AFB
57-2518	50	Jan 59	3 Dec 96	QF-106 (AD260); shot down with AIM-120, Tyndall AFB
57-2519	53	Feb 59	21 Apr 66	retired? (Sacramento ALC training aircraft)
57-2520	57	Mar 59	3 Oct 72	crashed 186th FIS
57-2521	60	Mar 59	2 Apr 85	destroyed in mid-air collision, 101st FIS
57-2522	63	Apr 59	21 Jan 98	QF-106 (AD259); shot down with AIM-120, Tyndall AFB
57-2523	65	Jul 58	4 Dec 92	prototype ARDC instrument test aircraft; later displayed, Atlantic City AP

The 25th Paris Air Salon in 1963 hosted two A-model Darts, 59-0124 and 59-0136, in the type's first trip across the Atlantic. Here the latter of the two is seen at Malmstrom AFB, Montana, in December 1969, while with the 71st FIS. In 1963, the aircraft was with the 48th FIS at Langley AFB, Virginia.



Prototype 56-0451, seen here while with the USAFM, later moved to Selfridge AFB, where it was displayed with a spurious serial number.

57-2524	69	Apr 59	20 Feb 97	QF-106 (AD258); shot down with 9K38 Igla (SA-18) SAM, Holloman AFB
57-2525	73	May 59	1 Nov 60	written-off (major damage) 95th FIS
57-2526	77	May 59	16 Oct 68	crashed ADWC
57-2527	82	Jun 59	9 Oct 73	crashed ADWC
57-2528	88	Jun 59	16 Oct 72	crashed ADWC
57-2529	95	Jul 59	21 Apr 66	retired? (Sacramento ALC training aircraft)
57-2530	102	Aug 59	24 Apr 97	QF-106 (AD257); shot down with AIM-120, Tyndall AFB
57-2531	109	Aug 59	30 Mar 66	crashed 539th FIS
57-2532	116	Sep 59	27 Mar 96	QF-106 (AD270); shot down with AIM-120, Tyndall AFB
57-2533	123	Sep 59	12 Dec 86	written-off (major damage); displayed Kelly AFB
57-2534	130	Sep 59	27 Jan 64	destroyed by fire 4756th ADW, Tyndall AFB
57-2535	137	Oct 59	1 Sep 93	QF-106 (AD109); shot down with AIM-9M, Tyndall AFB
57-2536	144	Oct 59	4 Mar 93	QF-106 (AD107); shot down with AIM-7M, Tyndall AFB
57-2537	150	Oct 59	28 Jan 98	QF-106 (AD276); shot down with AIM-120, Tyndall AFB
57-2538	157	Nov 59	19 Oct 72	crashed ADWC
57-2539	164	Nov 59	23 Aug 95	QF-106 (AD265); accidentally jammed by EF-111A/command destroyed, Tyndall AFB
57-2540	169	Nov 59	7 Jul 97	QF-106 (AD262); shot down with AIM-120, Tyndall AFB
57-2541	174	Dec 59	16 May 95	QF-106 (AD281); shot down with AIM-7M, Tyndall AFB
57-2542	179	Dec 59	27 Aug 64	crashed 4756th ADW, Tyndall AFB
57-2543	189	Jan 60	23 Feb 98	QF-106 (AD271); written-off (nose gear damaged on landing), Tyndall AFB
57-2544	201	Feb 60	29 Mar 71	crashed ADWC
57-2545	207	Feb 60	3 Jan 97	QF-106 (AD282); written-off (cracked intake duct), Tyndall AFB
57-2546	213	Mar 60	14 Jun 95	QF-106 (AD264); shot down with AIM-120/gun, Tyndall AFB
57-2547	219	Mar 60	15 Nov 96	QF-106 (AD279); shot down with AIM-120, Tyndall AFB
58-0900	226	Mar 60	10 Jul 95	QF-106 (AD274); crashed on landing, Tyndall AFB
58-0901	231	Apr 60	20 Dec 96	QF-106 (AD273); shot down with AIM-120, Tyndall AFB
58-0902	237	Apr 60	17 Jan 97	QF-106 (AD277); shot down with AIM-9M, Tyndall AFB
58-0903	243	Apr 60	3 Apr 84	AMARC§
58-0904	249	May 60	2 Apr 84	AMARC§
59-0149	254	May 60	6 Nov 97	QF-106 (AD261); shot down with AIM-120, Tyndall AFB
59-0150	259	May 60	4 Dec 97	QF-106 (AD278); shot down with AIM-9M, Tyndall AFB
59-0151	265	Jun 60	25 Nov 97	QF-106 (AD266); shot down with AIM-120, Tyndall AFB
59-0152	271	Jun 60	24 Jul 91	QF-106 (AD101); crashed after control loss, Tyndall AFB
59-0153	277	Jun 60	11 Sep 97	QF-106 (AD272); shot down with AIM-120, Tyndall AFB
59-0154	283	Jul 60	18 Dec 62	crashed 438th FIS
59-0155	289	Jul 60	16 Jul 97	QF-106 (AD269); shot down with AIM-120, Tyndall AFB
59-0156	295	Jul 60	1 Mar 64	crashed 11th FIS
59-0157	300	Aug 60	11 Feb 77	crashed 48th FIS
59-0158	305	Aug 60	23 Feb 98	QF-106 (AD275); later AMARC§
59-0159	310	Aug 60	5 Aug 93	QF-106 (AD119); shot down with AIM-9M, Tyndall AFB
59-0160	314	Sep 60	12 Jun 74	crashed 87th FIS
59-0161	318	Sep 60	22 Jan 97	QF-106 (AD280); shot down with AIM-120, Tyndall AFB
59-0162	322	Sep 60	9 Feb 71	crashed 84th FIS
59-0163	326	Oct 60	30 Sep 71	crashed ADWC
59-0164	330	Oct 60	4 Apr 84	AMARC§
59-0165	334	Oct 60	27 Feb 80	destroyed by fire ADWC

As the last F-106s bowed out with the New Jersey ANG in the summer/autumn of 1988, their place was taken by General Dynamics F-16A/Bs, which were upgraded to ADF standard during FY91. During the winter of 1994/95, they in turn were traded for F-16C/D aircraft.

F-106 Operators

Air Defense Command

The Air Force's F-106 fighter interceptor squadrons belonged to Air Defense Command (ADC, or ADCOM), headquartered at Ent AFB, Colorado. ADC was established on 21 March 1946 and, after numerous changes in the pre-Delta Dart era, was re-established as a major command on 1 January 1951. After Ent Field closed, ADC moved to new headquarters in the Chidlaw Building in Colorado Springs. ADC eventually became a component of NORAD (North American Air Defense Command) which combined US and Canadian efforts to defend against a trans-Polar bomber and missile attack. NORAD was established on 12 September 1957. For much of its existence, the ADC commander was also the NORAD commander-in-chief.

To reflect the growing importance of space, ADC's name was changed to Aerospace Defense Command on 15 January 1968. At the time, the term 'aerospace', devised by General Thomas D. White – who had been USAF chief of staff when the Soviet Union launched the first space satellite in October 1957 – was very much in vogue. White and others expected that the USAF would quickly be renamed the United States Aerospace Force and urged it repeatedly upon their bosses – the idea was revived during the service's 50th anniversary in 1997 – but it never happened. The term was all too apt to F-106 pilots who were expected to defend North American airspace against anything that came in, high or low.

The defence of North America, a top priority at the height of the Cold War, began to wane when it became evident there was no defence against ICBMs. It also became evident that the Soviet Union had a far less capable strategic bomber force than had been believed in the early days of the Cold War.

On 1 October 1979, ADC's F-106 squadrons were transferred to Tactical Air Command (TAC), which established a component called ADTAC, headquartered at Colorado Springs. All of the F-106 squadrons operated by the Air National Guard (ANG) were under state control for administrative purposes but were dedicated to ('gained' by) ADC and later TAC for the air defence mission. Under the 1979 reorganisation, the fighter interceptor squadrons were made subordinate to six air divisions – 20th, 21st, 23rd, 24th, 25th and 26th. A further change took place on 6 December 1985 when ADTAC was replaced by the newly-activated First Air Force. This command arrangement remained in effect until the last F-106s (operated by the New Jersey ANG) ended their career as fighter-interceptors and went to the boneyard.

Having given up its flying squadrons, ADC went out of business on 31 March 1980, inactivated as a major air command.

2nd FIS

On 1 July 1971 the 2nd Fighter Interceptor Squadron (FIS) was reactivated at Wurtsmith AFB, Michigan, equipping with F-106 aircraft and personnel from the 94th FIS. (The 94th designation on that date was transferred from ADC to TAC.) The squadron had previously operated the F-101B/F Voodoo at Suffolk County, New York.

The 2nd FIS competed in the 1972 William Tell gunnery meet at Tyndall AFB, Florida and took second place in the F-106 category, with 13,761 points out of a possible 16,800. The squadron's Delta Dart era was brief, however, and it began transferring its aircraft to the 171st FIS/191st FIG, Michigan ANG on 29 December 1972. The squadron had operated a total of 20 F-106s and lost none in mishaps. The 2nd FIS was inactivated on 31 March 1973. In later years, it became a T-33 operator as the 2nd FITS at Tyndall.

The 2nd FIS was unofficially known as the 'Horney Horses'. The 'winged unicorn' from the unit's badge appeared in a white disc over a yellow tail band.

5th FIS

The 5th FIS 'Spittin' Kittens' at Minot AFB, North Dakota received its first F-106A (59-0019) on 30 January 1960, having previously been equipped with the F-102A Delta Dagger. The squadron's history dates to 20 November 1940. Its first aircraft was the P-40. The squadron badge is a lynx ('kitten') against an azure disc broken by two flashes of lightning. Its aircraft have typically been decorated with yellow or yellow-enclosed lightning bolts. The squadron had previously operated the F-102 Delta Dagger at Suffolk County, New York.

The squadron carried out three White Shoes deployments to Alaska, beginning respectively on 4 January 1967, 3 April 1968 and 10 July 1969. In William Tell competitions, the squadron scored second in 1965, fifth in 1972, and third in 1980. One of the squadron's better-known commanders was Lieutenant Colonel Jack Broughton, later the author of *Thud Ridge* and other books, from 16 April 1962 to 30 June 1964.

On a rare deployment to Europe in 1975, seven aircraft went to Hahn AB, Germany, to support NATO Exercise Cold Fire 75. The F-106s arrived on 4 September 1975 and returned home on 27 September 1975. The 'Spittin' Kittens' was not the first squadron to operate the 'Six' in Europe, an honour that was claimed by the 48th FIS which had sent two aircraft to the 1963 Paris Air Show.

The squadron's last F-106A (59-0006) went to Davis-Monthan AFB, Arizona on 5 April 1985 to be converted to a QF-106A drone. During its F-106 tenure, the squadron operated 33 F-106s, nine of which were lost in mishaps. The 'Spittin' Kittens' in later years operated the F-15 Eagle, and subsequently became a training unit.

Right: The famous 'Spittin' Kittens' lightning bolt and stars appeared on later tail markings, as seen on these aircraft at William Tell '84.

Below: 'Spittin' Kittens' F-106s originally wore a large tail chevron as seen on this aircraft – the 5th FIS commanding officer's F-106 – seen in May 1974.

11th FIS

The 11th FIS 'Red Bulls' at Duluth Municipal Airport, Minnesota, part of the 30th Air Division, received the squadron's first F-106A (59-0080) on 23 June 1960. Previously, its aircraft had been the F-102 Delta Dagger. The 11th dates to 20 November 1940. The squadron badge depicts a charging red bull.

In William Tell 1961, the 11th FIS placed fourth, and two years later finished in second place. The 11th FIS made two White Shoes deployments to Alaska, beginning respectively on 6 September 1967 and 1 August 1968. The squadron frequently exercised at, and in wartime would have dispersed to, Volk Field, Wisconsin.

As a result of major changes that occurred throughout ADC on 30 September 1968, while four of its aircraft were away from Duluth on the squadron's second Alaskan deployment, the 11th FIS was discontinued at Duluth – a move that included the four aircraft in Alaska – where it was redesignated the 87th FIS. The latter squadron perpetuated the 'Red Bulls' nickname. During its tenure as a Delta Dart operator, the 11th FIS operated 33 F-106s and lost three.

Above right: A pair of 11th FIS F-106As drop in to Duluth IAP in the 1972 version of their markings. The nearer aircraft sports an ADC badge.

Right: Seen in May 1965 wearing an earlier form of 11th FIS markings and wing commander's stripes, this F-106A crashed in May 1981 while serving with the 87th FIS.

27th FIS

On 16 October 1959, an F-106A (58-0779) became the first Delta Dart to join the 27th FIS 'Fighting Falcons' at Loring AFB, Maine. The squadron patch depicts a red, yellow, and black falcon. This squadron had flown the F-102 Delta Dagger at Griffiss AFB, New York until officially relocated to Loring, effective 1 October 1959. Organised in 1917, the 27th is frequently described as the oldest American fighter squadron never to have been deactivated, although in fact it was briefly out of operation in 1945/46.

The 27th FIS had a detachment at Goose Bay, Labrador beginning in 1967 for about a year. For a brief period, the squadron also had a detachment at Dow AFB near Bangor, Maine. The 27th deployed five times to Alaska (on 4 May 1966, 1 November 1967, 29 January 1968, 30 August 1968, and 8 December 1969).

Under Operation College Shaft, the 27th FIS intercepted three Russian Tupolev Tu-95 'Bears' on 13 May 1969, using two F-106s scrambled from Loring. Two hours and 33 minutes from launch, the two F-106s caught up with the Russian bombers at a point within 150 miles (241 km) of North America and 700 miles (1126 km) from Loring. This was the first intercept of Soviet aircraft by interceptors based in the continental US.

During its Delta Dart tenure, the 27th FIS operated 49 F-106 airframes and suffered five losses. On 1 July 1971 the connection between the 27th FIS and the F-106 was severed when the squadron identity was moved to Langley AFB, Virginia as the 27th TFS. As a replacement, the 83rd FIS was reactivated at Loring.

Below: Tail markings were not confined to the single-seaters. F-106Bs were as capable an interceptor as the A model, most units having at least one example for continuation training purposes.

Above: This close-up of the tail of a 'Fighting Falcons' F-106 shows the tail marking design as it appeared in June 1969.

48th FIS

The 48th FIS was dubbed the 'Tasmanian Devils'. The squadron used a patch with an animated, Satan-like character before shifting to a less evocative starburst symbol. The 48th FIS at Langley AFB, Virginia received its first F-106 (59-0157), a B model, on 15 September 1960. Previously, the squadron operated the F-102 Delta Dagger.

In May 1963, the 48th became the first squadron to deploy an F-106 overseas when F-106A 59-0136 flew to the 25th Paris air show. On 7 September 1966, the squadron began the first of three White Shoes deployments to Elmendorf AFB, Alaska. Two further deployments began on 3 May 1967 and 7 April 1969.

The 48th FIS deployed to Korea in the wake of North Korea's seizure of the spy ship USS *Pueblo* (AGER-2). Beginning 11 July 1968, the 48th began standing alert at Osan AB, Korea, using aircraft left in place by the 318th FIS. The 48th FIS personnel left on 23 December 1968, the day the *Pueblo* crew was released, flying the 318th squadron's Delta Darts to McChord before returning home for Christmas.

Under Project College Sand, the 48th began standing alert at Homestead AFB, Florida on 3 June 1970. This deployment occupied six aircraft operating as a detachment at Homestead until May 1976.

On 1 October 1979, the 48th transferred from ADC to TAC. In February 1982, the squadron began retiring its F-106s to the 'boneyard' at Davis-Monthan AFB, Arizona. The 48th FIS had participated twice in the William Tell gunnery meet, scoring third in the F-106 category in 1963 and 1978. During its time as a Delta Dart operator, the squadron flew 45 airframes and sustained seven losses. The squadron continued to fly the air defence mission with the F-15A.

Right: From the mid-1960s until at least 1972, the 48th FIS used a comparatively simple broad white band, outlined in black, as its distinctive unit identifier.

Left: The last markings scheme applied to 48th Fighter Interceptor Squadron F-106s, seen here in March 1976, consisted of a white chevron with blue trim and alternating rudder stripes.

F-106 Operators

49th FIS

On 30 September 1968, the 438th FIS at Kincheloe AFB, Michigan was moved to Griffiss AFB, New York and redesignated the 49th; it acquired the assets of the discontinued 438th FIS. Previously, the 49th FIS appellation had belonged to the F-101B/F Voodoo squadron at Griffiss and was inactive for a time. The squadron was officially nicknamed the 'Cavaliers' because of its emblem depicting a knight in armour; the application of a large eagle with a green-white sunburst to its aircraft meant that the squadron was known less officially as the 'Green Eagles'.

On 8 September 1969, the squadron deployed to Alaska to replace the 84th FIS. In the William Tell competition, the 49th FIS scored second in the F-106 category in 1974, second in 1976, first in 1978, fourth in 1980, and first again in 1982.

Between 1983 and 1986, the squadron operated a detachment at Loring AFB, Maine.

On 1 October 1979, the 49th FIS – like all other interceptor squadrons in ADC – transferred to TAC. By the mid-1980s, it had become the last active-duty USAF squadron

flying the F-106. The squadron operated 23 airframes and lost five. It flew the remaining 18 F-106s into retirement at the 'boneyard' at Davis-Monthan AFB. The first to arrive was 59-0065 on 12 January 1982, and the last two – 59-0062 and 59-0136 – were on 9 July 1987. The 49th hoped to get F-15s, but the Air Force decided to inactivate the squadron on 1 July 1987. The squadron has since reappeared (from 1993) as an AT-38B IFF (Introduction to Fighter Fundamentals) squadron at Columbus AFB, Mississippi.

Above: During 1973, 49th FIS markings consisted of rudder stripes.

Right: By 1984, the full 'Green Eagle' had appeared. Yellow lightning bolts adorned fuel tanks.

71st FIS

The first F-106 assigned to the 71st FIS at Selfridge AFB, Michigan was F-106B 57-2532 on 17 October 1960. The Delta Dart era began after a long association by the 71st FIS with the F-102 Delta Dagger.

During the Cuban missile crisis in October 1962, the squadron deployed to Patrick AFB, Florida to provide air intercept capability. The squadron operated a detachment at Hulman Regional Airport in Terre Haute, Indiana, from the mid-1960s until the early 1970s. The squadron finished first in the F-106 category at William Tell gunnery meets in 1965 and 1970. The 71st had three deployments to Alaska in support of Operation White Shoes on 3 December 1965, 4 January 1968 and 2 February 1970. The 1968 move marked the first time air-to-air refuelling was used on a White Shoes deployment. In support of Project College Cadence deployments to Korea, the 71st arrived at Osan on 23 December 1968 and began standing alert until 17 June 1969.

The 71st FIS made two real moves, as distinguished from the 'paper' transfers that occurred when designations shifted: on 15

January 1967 the unit relocated to Richards-Gebaur AFB, Missouri (from which the first air-refuelled Alaskan deployment was launched) and on 1 July 1968 to Malmstrom AFB, Montana. On 1 July 1971, as part of the 1st FIW transfer to TAC, the 71st designation was transferred to Langley AFB, Virginia, losing its status as an air defence unit. The squadron at Malmstrom was

In 1970, not long after their return from Korea, 71st FIS Delta Darts could be seen with this smart blue chevron marking.

redesignated the 319th FIS. During its time as an F-106 operator, the 71st FIS flew 56 aircraft and sustained six losses.

83rd FIS

On 1 July 1971, the 83rd FIS was reactivated at Loring AFB, Maine, using the aircraft and crews left by the 27th FIS. In a previous life, the 83rd had been at Hamilton AFB, California flying F-101B/Fs and had inactivated on 1 July 1963.

The brief, new history of this squadron ended on 30 June 1972 when the 83rd FIS was inactivated, with its 17 F-106s being reassigned to the 95th FIS at Dover AFB, Nebraska. The squadron had operated a total of 20 aircraft during its F-106 era.

A rare photograph of a comparatively rare bird, this shot shows an F-106A of the short-lived 83rd FIS, seen here at McConnell AFB during October 1971. Darts equipped the 83rd in 1971, the unit having operated Voodoos eight years previously.

84th FIS

The 84th FIS 'Black Panthers' flew F-106s at Hamilton AFB, California and Castle AFB, California. Previously, this squadron had flown the F-101B/F Voodoo at Hamilton. On 30 September 1968, the 498th FIS moved from Paine Field, Washington with its F-106s to Hamilton AFB, California and was redesignated 84th FIS.

The 84th deployed twice to Alaska, on 5 June 1969 and 15 June 1970. In its only participation in the William Tell weapons meet, the squadron scored second in 1970. On 2 October 1970, the 84th returned to Hamilton, ending 11 years of White Shoes/College Shoes deployments to Alaska.

On 1 September 1973, the 84th FIS

The 84th FIS 'Black Panthers' initially adopted the markings of the 498th, whose aircraft it had taken over in 1968.

moved to Castle AFB, California. In 1977, the squadron deployed seven F-106s to Eielson AFB, Alaska for two weeks in support of the Jack Frost 77 winter exercise.

The squadron was redesignated 84th Fighter Interceptor Training Squadron on 3 June 1981. In this capacity, the squadron operated T-33A Shooting Stars as 'faker' or aggressor aircraft for radar evaluation. Its F-106s were transferred to other units in the USAF/ANG. During its F-106 era, the squadron operated 39 F-106 aircraft and sustained four losses.

By 1974, a red/white/blue tail stripe and badge were seen on the tail of the 84th's Darts.

87th FIS

The 87th FIS became an F-106 operator at Duluth Municipal Airport, Minnesota on 30 September 1968. The squadron retained the 'Red Bulls' nickname of the former 11th FIS and adopted a similar patch with a differently styled bull. Formerly, the 87th had been an F-101 Voodoo squadron at Lockbourne AFB, Ohio, until deactivation in June 1968. In May 1971, the squadron moved to K. I. Sawyer AFB, Michigan, where it began full operations on 24 May 1971. For many years the squadron also maintained a detachment at Charleston AFB, South Carolina. The squadron also had a detachment at Volk Field in Camp Douglas, Wisconsin until 1974.

In April 1975, the 87th deployed F-106s to Luke AFB, Arizona for DACT (dissimilar air combat training) with the F-15 Eagle training unit.

On 21 April 1978, nine F-106s departed K. I. Sawyer for Keflavik AB, Iceland, one aborting en route. Soon afterward, the squadron's first intercept of a Soviet Tupolev Tu-95 'Bear' (of three) was made by Captains Gene Lutz and Bill Thomas. The eight F-106s arrived back at K. I. Sawyer on 13 May 1978.

On 1 October 1979, like other Delta Dart squadrons in the active force, the 87th FIS transferred from ADC to TAC.

The 87th FIS stood down from alert duty at K. I. Sawyer on 1 February 1985 and at Charleston on 1 July 1985. During its F-106 era, the squadron had operated 31 F-106s and suffered four losses. When the 87th FIS was inactivated on 1 October 1985, an F-106A (57-0230) was left behind at Charleston for display. This aircraft had been the YF-106C prototype.

Above right: An 87th FIS F-106A is seen at an air show at Rickenbacker AFB, Ohio in the early 1960s. The starboard side of the fin carried the ADC insignia. Note also the 'FE' 'buzz' code used during this period, but abandoned in the early 1960s.

Right: The 87th 'Red Bulls' adopted this stylised bull's head in the early 1970s and used it, with variations, until it gave up its 'Sixes'.

94th FIS

The 94th FIS 'Hat in the Ring' squadron took delivery of its first F-106A (58-0796) on 3 April 1960 at Selfridge AFB, Michigan. The USAF's second-oldest squadron, which claimed Captain Edward Rickenbacker as the American ace of aces in World War I, went directly into the Delta Dart from the F-86L Sabre. The unit never took part in a William Tell competition. The 94th deployed to Alaska three times: 7 September 1966, 28 February 1968, and in July 1970.

In support of Project College Cadence deployments during the *Pueblo* crisis, the 94th deployed to Osan AB, Korea where it used aircraft of the 71st FIS to begin alert duty on 17 June 1969.

On 1 December 1969, the 94th designation was moved to TAC while the 2nd FIS was activated at Wurtsmith to replace the 94th. During its F-106 era, the 94th FIS operated 45 F-106s and experienced five losses. The relocated squadron became today's 94th FS operating the F-15C Eagle.

Left: The original 94th FIS markings featured the 'Hat in the Ring' in a blue 'V' cut into a band of red and white stripes. The final marking used was a narrow yellow fin band with the badge on a white disc.

Above: At least one 94th FIS F-106A, seen at Andrews in June 1967, wore a variation on the scheme with the tail band based on the elements of the 1st FW insignia.

95th FIS

The 95th FIS 'Mr Bones' was assigned its first F-106A (57-0246) on 17 July 1959 while stationed at Andrews AFB, Maryland. There, the squadron had previously operated the F-86D and F-102. On 1 July 1963, the 95th relocated from Andrews to Dover AFB, Delaware.

The squadron did not participate in any Alaskan deployments. The 95th was the last F-106 unit to deploy to Korea following the *Pueblo* crisis, arriving at Osan on 15 November 1969 to replace the 94th FIS. During the Korean deployment, the squadron lost one aircraft which is believed to have flown into the sea. The date of the end of the Korean operation is in dispute, but a squadron member recalls that the 95th left Korea in May 1970.

The 95th FIS participated in the William Tell weapons meet just once, placing last among six teams in 1972.

On 31 January 1973, the 95th FIS was inactivated at Dover. Most of its F-106s were assigned to the 101st FIS, Massachusetts ANG, at Otis ANGB. Forty-nine F-106s had been operated by the 95th squadron, of which four were lost in mishaps. Today the squadron identity survives with the 95th FITS at Tyndall AFB.

The 95th FIS put its badge on a blue and yellow diamond. Seen in the background is a KC-97 of the Delaware ANG.

'Mr Bones' F-106s originally featured the squadron badge in a large disc on the tail, as seen on these examples photographed in 1963.

318th FIS

The 318th FIS at McChord AFB, Washington was assigned its first F-106A (59-0055) on 21 March 1960. Like so many users of the 'Six', the 318th had flown the F-102 Delta Dagger. The 318th took the brunt of the first White Shoes deployments to Alaska. Five F-106s of the 318th arrived at Elmendorf AFB, Alaska, on 15 July 1963 along with four F-106s from the 498th FIS. In all, the 318th made seven deployments to Alaska.

The squadron also deployed to Tyndall AFB, Florida five times to participate in the William Tell competition, achieving first place in 1963, fourth in 1965, third in 1970, third in 1972 and third again in 1974. The squadron also initiated the Project College Cadence deployments to Korea during the *Pueblo* crisis. On 20 November 1967, 10 F-106As of the 318th flew non-stop from McChord to Tyndall with air-to-air refuelling. This was the first test of College Cadence.

In the spring of 1974, squadron F-106s deployed to Howard AFB in the Panama Canal Zone for Exercise Blackhawk '74.

With other surviving 'Six' squadrons, the 318th was transferred to TAC on 1 October 1979. On 2 November 1983, the squadron ended its Delta Dart era as the last F-106 departed McChord. One of the last active-duty air defence outfits, the 318th was an operator of the F-15A/B Eagle before being inactivated on 7 December 1989.

Left: The last markings worn on 318th FIS Darts were the full-size North Star as seen on these aircraft at Tyndall AFB.

Right: Earlier versions of the unit's marking were in the form of this two-tone blue, three-tailed dart shape. Note the '0' serial number prefix, indicating that the aircraft was over 10 years old.

319th FIS

The 319th FIS flew the F-106 twice. The first period began at Bunker Hill AFB, Indiana with the arrival of the first aircraft (59-0020) on 2 February 1960. The 'Six' was, needless to say, an auspicious replacement for the squadron's F-89J Scorpions. This squadron's Delta Dart era ended for the first time in February 1963 as the F-106s began departing Bunker Hill in anticipation of the squadron's upcoming move to Homestead AFB, Florida and its transition to the F-104A/B Starfighter, beginning on 1 March 1963. Records show that F-106A 59-0021 was the last to leave Bunker Hill, on 9 March 1963. In three years, the squadron operated 26 F-106s, lost one in a crash, and had one damaged.

On 1 July 1971, the 319th was reactivated at Malmstrom AFB, Montana to take over the equipment and people of the departing 71st FIS. On 30 April 1972, the 319th was inactivated. The 18 F-106s it operated during this brief period were all ex-71st FIS aircraft. The last F-106A (59-0146) departed on 24 May 1972.

The markings of the 319th FIS, in its second incarnation (1971-72), came from the 71st FIS, whose aircraft it inherited.

329th FIS

At George AFB, California, the 329th FIS received its first F-106s on 29 July 1960. The squadron had operated the F-102 at George. In October 1964, the 329th was awarded the Hughes Trophy for air defence excellence. The squadron began to give up its F-106s in May 1967. An F-106A (59-0108) and an F-106B (59-0162) were the last Delta Darts to depart, on 9 June 1967. The squadron operated 31 F-106s and had three losses. The 329th FIS was inactivated on 31 July 1967.

The 329th FIS, a former Delta Dagger unit, adopted a squadron badge featuring a stylised delta-winged aircraft. It appeared in the centre of a three-pointed chevron on the unit's Darts in the 1960s.

437th FIS

On 18 July 1968, the 437th FIS came into existence at Oxnard AFB, California with the redesignation of the former 456th FIS. The squadron's former equipment was the McDonnell F-101B/F Voodoo. Equipping with the Delta Dart turned out to be a temporary measure, although, in its tenure of just two months, the squadron operated 21 F-106s. On 30 September 1968, the 437th FIS was discontinued. The aircraft and people remaining in place at Oxnard were redesignated the 460th FIS because the latter name was regarded as having a more distinguished history.

The 437th FIS was the shortest-lived F-106 squadron and used the markings of the 456th FIS, whose colours it inherited with the redesignation of that unit. This aircraft, seen refuelling from a KC-135 in September 1968, was lost in December 1972.

438th FIS

The 438th FIS began operation at Kincheloe AFB, Michigan (formerly Kinross AFB) on 12 May 1960 with the arrival of its first F-106A (59-0068). The squadron insignia was a copyrighted picture of Donald Duck in a flight jacket and dates to World War II when the 438th conducted replacement training at Kinross Field. Immediately prior to the 'Six', the squadron flew the F-102. The squadron maintained a detachment at Phelps-Collins Airport in Alpena, Michigan throughout much of the 1960s. It made two Alaskan deployments, replacing the 94th FIS on 1 March 1967 and 29 May 1968.

On 30 September 1968, the 438th FIS was relocated to Griffiss AFB, New York, discontinued, and redesignated the 49th FIS. This change also affected squadron F-106s that were then in Alaska on a White Shoes deployment. During its Delta Dart period, the 438th FIS operated 29 aircraft and had four losses.

Left: In this later variation of the unit's tail markings, the 'Donald Duck' design is facing to the right; on some aircraft this was reversed.

Above: Seen at Milwaukee in 1965, this 438th FIS Dart shows the first version of squadron markings.

456th FIS

F-106A 58-0761 arrived to join the 456th at Castle AFB, California on 16 September 1959, ushering in the squadron's Delta Dart era. The 456th competed in the William Tell weapons meet on three occasions, scoring first in 1961 (the first year the Delta Dart appeared), fourth in 1963 and third in 1965.

The 456th FIS had 64 F-106s assigned and sustained three losses. On 2 July 1968, the squadron was relocated to Oxnard AFB, California, and on 18 July 1968 the 456th was discontinued and redesignated the 437th FIS.

456th FIS F-106s wore the squadron badge on the starboard fin. The tail bands changed from black to blue in later years and the flash disappeared from the central badge.

460th FIS

460th FIS aircraft initially wore the markings of the 437th FIS, later adapting them as seen here in 1972.

On 30 September 1968, the 460th FIS was reactivated as an F-106 user at Oxnard AFB, California through the redesignation of the 437th FIS. In a previous incarnation, the squadron had flown the F-102. The 460th FIS made its only White Shoes deployment to Alaska on 9 December 1968, replacing the 87th FIS. On 1 December 1969, the squadron relocated to Kingsley Field, Oregon as part of the 408th Fighter Interceptor Group. After a little more than a year there, the 460th FIS moved to Grand Forks, North Dakota on 16 April 1971.

In April 1972, the squadron transferred all of its F-106s to the Montana ANG's 186th FIS (these were to become the last Delta Darts in service with 'round' cockpit gauges, never receiving the taped instruments that were retrofitted to most examples) while taking charge of a new batch of F-106s formerly assigned to the 319th FIS. In 1972, the 460th FIS won first place in the F-106 category at the William Tell weapons competition.

When it went out of business in 1974, the 460th FIS had operated 42 F-106s and had sustained just one loss. The 460th FIS was discontinued on 15 July 1974. Most of its F-106s from the second batch were transferred to the California ANG's 194th FIS at Fresno.

498th FIS

Aircraft history cards indicate that the first F-106 Delta Darts were assigned to the 498th FIS at Geiger Field, Washington on 2 June 1959. This airfield was renamed Spokane International Airport in August 1960. The 'Geiger Tigers' were among the most colourful squadrons in the Air Force and made a dramatic movie about their days in the F-86D Sabre. A different historical record which appears less credible shows an F-106A (57-2462) being accepted on 27 May 1959 and delivered on 28 May 1959 to the 498th FIS at Geiger Field. The abundance of historical evidence now has it that the 539th FIS at McGuire became the first F-106 operator three days later. At the time, press releases credited the Geiger-based unit with being first with the 'Six'.

On 1 July 1963, the 498th FIS moved to McChord AFB, Washington after a swap of F-106s with the 456th FIS. On 15 July 1963, the 498th arrived at Elmendorf with the initial White Shoes deployment. A continuous rotation with the 318th FIS was maintained until 3 December 1965. The 498th FIS made two more deployments to Alaska on 4 May 1966 and 5 July 1967. On 14 June 1966, the 498th relocated to Paine Field, Washington. On 30 September 1968, the squadron relocated to Hamilton AFB, California, was discontinued, and was redesignated the 84th FIS. As the 498th FIS, it had operated 65 Delta Darts and experienced seven losses.

Above: When based at Geiger Field, the 498th proudly wore a large 'Geiger Tiger' badge on the fins of its F-106s.

Right: This 'compass' tail design appeared in the 1963-64 period when the 498th FIS was based at McChord AFB.

539th FIS

The 539th FIS (known unofficially as 'Iron Hand') had the distinction of being the first Air Defense Command unit to operate the F-106 Delta Dart. An operator of the F-86L Sabre, the 539th was fortuitously located at McGuire AFB, New Jersey, which was also the site of the East Coast SAGE (Semi-Automatic Ground Environment) air-intercept system. The squadron emblem, dating to its reactivation with F-86s in 1954, depicts a mailed fist reaching down to destroy a bomber. At one time, the 539th had been scheduled to operate the F-102 Delta Dagger, but it moved directly to the F-106 instead.

Aircraft record cards show the first two F-106s arriving at McGuire on 30 May 1959. Other history records support this date, although maintenance records at ADC indicate that the date was 1 May 1959. Yet another historical record shows an F-106A (57-2457) being accepted by the USAF on 10 April 1959 and delivered on 17 April 1959 to the 539th FIS at McGuire AFB. In the absence of a way to reconcile the conflicting dates, the 30 May 1959 date is regarded as the most credible. It should be noted that the 539th did not become operational immediately in the F-106, and performed essentially as a field test unit for the early part of its existence. Thus, the first operational squadron was the 498th FIS at Geiger Field.

The 539th competed in the 1961 William Tell weapons meet, finishing in third place in the F-106 category. The 539th did not participate in any deployments outside the continental US. The squadron was discontinued on 31 August 1967. It operated 26 F-106s and suffered five losses.

Above: This 539th FIS F-106B, complete with a full load of AIM-4s, wears the last form of marking used by the unit before disbandment. A light blue colour was also used for the lightning bolt on some aircraft.

Below: The 539th FIS's first tail marking was a triangle pierced by a chevron.

Air National Guard

The ANG became a Delta Dart operator in April 1972 when the first aircraft were delivered to Montana's 186th FIS. Six Guard units flew the F-106 up to August 1988 when the 119th FIS, New Jersey ANG sent its last aircraft to AMARC at Davis-Monthan AFB, Arizona. All Air National Guard squadrons which operated the F-106 were 'ADC-gained' units which performed the Air Defense Command mission.

101st FIS Massachusetts ANG

The first two F-106s for the 101st TFS (57-2466 and 57-2524) were assigned on 28 April 1972. On 10 June 1972, the 101st TFS and its parent 102nd TFG were redesignated FIS and FIG. The squadron's initial batch of Delta Darts comprised 18 F-106As and one F-106B from the 95th FIS plus one F-106B from the ADWC.

The squadron made its first intercept of a Tu-95 'Bear' bomber off the coast of New York on 15 April 1975. The 101st FIS competed in three William Tell weapons events, scoring fourth place in 1978, second in 1980, and third in 1984. The squadron's Delta Dart era ended on 10 February 1988 when Lt Col Chuck Townsend flew out the last F-106 (57-2501/14). The squadron had operated 26 F-106s, suffering two losses.

Variations in the Massachusetts Guard's F-106 tail markings centred around the use of either the ANG badge or that of the 101st FIS.

119th FIS New Jersey ANG

The very last military operator of the Delta Dart was the 119th FIS/177th FIG, the 'Jersey Devils'. The squadron's first F-106A (59-0048) was assigned on 30 October 1972 at the Atlantic City, New Jersey airport. On 11 October 1974, F-106A 59-0044 collided in mid-air over Saxis, Virginia, with Piper PA-24-250 N6876P, but recovered safely. In 1984, at the final William Tell competition in which F-106s participated, the 'Jersey Devils' took first place and Major Lynn Robinson was named F-106 Top Gun.

Of the 20 aircraft initially assigned, 18 came from the 95th FIS, one from the 318th FIS, and one from AFLC. In all, the squadron operated 29 airframes and listed no losses.

The operational career of the F-106 Delta Dart came to an end on 1 August 1988 when the 'Jersey Devils' flew away their last three aircraft, two F-106As (59-0043, 59-0046) and one F-106B (59-0149).

A 'Jersey Devils' F-106 approaches the Jersey shore in 1981. These are the later markings as worn by the unit, retaining the red intake ramps of the earlier scheme.

In company with the unit's T-33, a pair of Jersey 'Sixes' displays the earlier, and less elaborate unit markings, with 'Jersey Devils' titles.

159th FIS Florida ANG

The 159th FIS/125th FIG in Jacksonville, calling itself the 'Fang' after the abbreviation of its Guard status, became a user of the Delta Dart on 29 May 1974 with the arrival of the unit's first F-106B (57-2523). Of the first 15 aircraft received in 1974, three F-106As and one F-106B came from the 84th FIS, one F-106A and one F-106B from the 460th FIS, four F-106As from the 171st FIS, and five F-106As from the 119th FIS.

The squadron has always had a lightning bolt on the tail flash. The group patch has a palm tree with winged arm clutching a lightning bolt. The squadron patch shows an F-106 climbing out.

In the 1976 William Tell competition, the 159th FIS finished in fourth place. The squadron did not participate again, but at William Tell in 1986 F-106s from the 159th FIS were used as targets by other interceptors at the meet.

Beginning in 1984, the squadron operated a three-aircraft detachment at Homestead AFB, Florida which it maintained throughout the rest of the squadron's F-106 period. The squadron operated 43 F-106s and sustained two losses.

March 1987 marked the end of this squadron's Delta Dart period. The last large group of aircraft to depart was five F-106As plus one F-106B, on 3 March 1987. The final Delta Dart to leave the squadron, an F-106B (57-2509) which became a B-1B bomber chase aircraft, was late in departing because it was awaiting a vertical tail tip: it finally left the 159th FIS on 23 March 1987. The squadron converted to the F-16A/B Block 15 ADF in 1987, and has since become an operator of the F-15A/B Eagle.

Florida ANG Darts carried a simple unit marking of a blue band with thunderbolt during their 13-year career.

171st FIS Michigan ANG

The 171st FIS/191st FIG 'Six Pack', at Selfridge Field, received its first F-106A (58-0767) on 29 December 1972. The squadron's initial batch of 18 aircraft came from the 2nd FIS and consisted of 18 F-106As and two F-106Bs. The squadron operated the Delta Dagger for fewer than six years, replacing them with McDonnell Douglas F-4C Phantoms.The last aircraft to depart this squadron was an F-106B (59-0150) which transferred to the 84th FIS on 16 August 1978. The squadron operated 24 Delta Darts in all, and experienced no losses.

Above right: In 1973, the Michigan ANG's aircraft carried simple markings, featuring the older-style circular ANG badge.

Right: A pair of 'Six Pack' two-seaters sits on the ramp at Selfridge. No squadron, wing or ANG badge was worn by the 171st, though the legend 'Michigan' appeared near the top of the fin and the squadron's nickname was sometimes applied to fuel tanks.

186th FIS Montana ANG

The first Air National Guard unit to operate the Delta Dart, the 186th FIS/120th FIG received its first two F-106As (57-2485 and 57-2487) on 3 April 1972. The squadron was located at the Great Falls airport. Its initial batch of 21 F-106s consisted of one F-106A from the 319th FIS, one F-106A and one F-106B from the ADWC, and 17 F-106As and one F-106B from the 460th FIS.

The 186th FIS did well in William Tell weapons meets: first place in 1974, first in 1976, second in 1978, and second in 1982. In 1985, the Montana ANG won the Hughes Trophy. The 186th FIS was the last F-106 squadron to participate in a Red Flag exercise at Nellis AFB, Nevada, in 1986. The squadron ended its F-106 era when its last two F-106Bs (57-2517 and 57-2530) left on 26 June 1987 for transfer to the 101st FIS. The squadron operated 27 F-106s and had six losses.

The unit designation and location is spelled out on the long fuel tanks of this F-106A at Andrews AFB in 1973.

F-106 Operators

194th FIS California ANG

The 194th FIS/144th FIG, located at Fresno airport, received its first F-106A (58-0774) on 8 May 1974. The squadron's initial complement of 16 F-106s included one F-106B from the 159th FIS, one F-106A from the 119th FIS, three F-106As and one F-106B from the 171st FIS, and one F-106B from the 460th FIS. The 194th competed at William Tell twice, ranking first in 1980 and fourth in 1982. The beginning of 1984 saw the end of the F-106 era for the 194th FIS. The last four F-106As (58-0780, 59-0011, 59-0038 and 59-0059) left on 13 January 1984 for reassignment to the 49th FIS.

Top: From 1974 to 1982, the 194th used this scheme, depicting the bear symbol of California on a white background, with the 'California' legend below on a red stripe.

Above: This much plainer scheme was in use in 1982. TAC and unit badges appeared on opposite sides of the fin.

Other operators

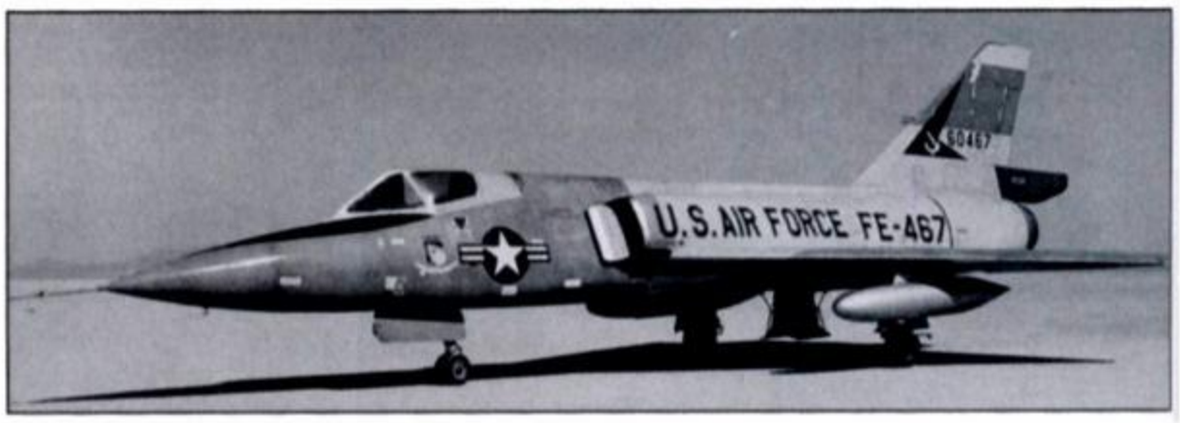
Edwards AFB special units

The Air Force Flight Test Center (AFFTC) performed much of the operational and developmental work with the F-106. Throughout most of the F-106 era, AFFTC was part of ARDC (Air Research and Development Command). On 1 April 1961, this formation was renamed Air Force Systems Command (AFSC), the name it retained throughout the remainder of the service life of the F-106. On 1 July 1992, prior to the use of the F-106A as a tow subject, this formation became Air Force Materiel Command (AFMC), the name it uses today. The first Delta Dart assigned to Edwards was an F-106B (57-2507) sent to 'the Center' but not officially to any numbered unit for Category II tests, after the manufacturer performed the Category I phase. Among other things, this F-106B was used to test the Delta Dart's first and second ejection seat designs.

The 6510th Test Wing of the AFFTC at Edwards did much of the testing and developmental work on USAF aircraft, including the F-106. The 6511th Test Group conducted parachute tests.

The early developmental work on the Delta Dart was performed by AFFTC. To maintain F-106 expertise, the 4786th Test Squadron was activated on 31 December 1969 at Edwards and for a prolonged period operated one F-106B (57-2512). On 1 March 1971, this unit was reassigned to the Air Defense Weapons Center at Tyndall; it was inactivated on 15 April 1972. F-106s were also operated by the Test Pilots School at Edwards. In addition, F-106s which remained on bailment to Convair were flown at Edwards.

Many years later (in 1997), an AFFTC NC-141A StarLifter wrote the final chapter of the F-106 story. The NC-141, belonging to the AFFTC's 418th FLTS, towed a NASA-owned F-106A (59-0130) in tests aimed at exploring reusable space vehicle technology. The tests were conducted between 20 December 1997 and 20 February 1998



Speed-record-breaking aircraft 56-0467 is seen here at Edwards with ARDC and AFFTC badges.

F-106 aircraft at AFFTC/Edwards included 56-0451/-0452 (programmed to be available to the Center by May 1957). Others were: 56-467, 57-234, 57-241/242; 57-245, 57-2507, 57-2509, and 57-2512.

F-106s that flew at Edwards while on bailment to Convair included 56-451, 56-459 (engineering support), 57-230 (structural demonstration) and 57-2509. Aircraft 56-455 was used for structural testing at either Edwards or Palmdale; records are unclear.

Tyndall AFB special units

F-106s were operated at Tyndall AFB for almost 25 years. From the arrival of the first F-106A (58-0778) on 26 October 1959 until the departure of the last two Delta Darts (F-106Bs 58-0900 and 58-0902), the base in the Florida panhandle was "the mover and shaker for the F-106 fleet", as one expert described it. Tyndall operated 80 F-106s and sustained nine losses.

Tyndall units included the following: 73rd Air Division/Air Defense Weapons Center; 4756th Air Defense Group/Wing; USAF Interceptor Weapons School (IWS); 4756th Air Defense Sqn (Wpns); 4757th Air Defense Sqn (IWS); 62nd Fighter Interceptor Training Squadron (FITS); 319th FITS; 4756th Combat Crew Training Squadron (CCTS); 2nd FITS; 4750th Test Squadron (TS); 475th TS; 4786th TS (at Edwards AFB for YF-12 evaluation); and the Southern Air Defense Alert Scramble Section (SADASS) 'The Dixie Darts'.

The 73rd Air Division/Air Defence Weapons Center initially painted its F-106s as seen here, at Tyndall in 1963, prior to the removal of buzz numbers from USAF aircraft.

Right: Later in the 1960s, the red/white/blue trim seen at right was adopted. The ADWC badge on the tail was later replaced with its TAC equivalent.

Air Materiel Areas/Air Logistics Centers

Throughout the lifetime of the F-106, the USAF operated three depots for major aircraft maintenance and repair work. These were the Sacramento Air Materiel Area at McClellan AFB, California, the San Antonio Air Materiel Area at Kelly AFB, Texas, and the Oklahoma City Air Materiel Area at Tinker AFB, Oklahoma. These three depots were operated by AMC (Air Materiel Command) which became AFLC (Air Force Logistics Command) on 1 April 1961.

Today's successor to these major commands (since 1 July 1992) is AFMC (Air Force Materiel Command). In the 1970s, the Air Materiel Areas were redesignated ALCs (Air Logistics Centers).

Sacramento ALC was the depot-level maintenance and repair facility for the F-106. Here, the aircraft underwent periodic inspections, maintenance, and repair that could not be performed at the base level but which did not require a return to the factory. Sacramento operated several of the aircraft (apparently without distinctive markings) throughout the type's career. At the time, the depot command did not follow the practice, adopted later, of having a numbered flying squadron. F-106s were operated by the Flight Test Branch, Quality Control Division, Directorate of Maintenance, SAMA.

Flight test: SA/OCF included an F-106A (57-2453) and an F-106B (57-2517) used in the modification and maintenance programme, an F-106B (57-2512) used after 12 October 1959 for development and evaluation of technical data, and an F-106A (59-0061) used for pilot proficiency.

San Antonio ALC was the depot-level maintenance and repair facility for the complex Hughes MA-1 electronic fire-control system and operated at least one F-106A and one F-106B. Oklahoma City ALC was available as an alternate source of depot work for temporary periods but apparently did not have an ongoing F-106-related programme or any F-106s assigned.

San Antonio Logistics (SAL) F-106s did not wear a special colour scheme, although this one (59-0061) was tested in air superiority blue with a Dayglo tail and the unit's name on the drop tanks.

Hanscom Field units

Hanscom AFB, Massachusetts has long been a centre of USAF developmental work in radar and other electronic equipment, and was one location which tested the MA-1 fire-control system, the revolutionary datalink system, and the IFF kit on the F-106. Users of the Delta Dart at Hanscom Field included the 6520th Test Group and the AFCRC (Air Force Cambridge Research Center/Laboratories).

The 6520th TG was part of the Electronic Systems Division of ARDC (Air Research and Development Command), which became AFSC (Air Force Systems Command) on 1 April 1961. Today's equivalent command (since 1 July 1992) is AFMC. The designation of this flying group was unusual, in that units in the 65xx series were usually located at Edwards AFB, California. Furthermore, the 6520th was short-lived, eventually (by the late 1970s) being reorganised into the 3245th Maintenance and Supply Group. Its role as an operator of two F-106As (57-2490/2491) was connected with ongoing tests and operational evaluation of the MA-1, datalink system, and IFF system on the Delta Dart, all of which were quite advanced for the time.

AFCRC (Air Force Cambridge Research Center/Laboratories), also known as the Hanscom Complex after Hanscom AFB, Massachusetts, teamed with MITRE (a private company 'think tank' founded by Robert R. Everett in 1958) and Lincoln Laboratories to test the F-106 SAGE (Semi-Automatic Ground Environment) system in a way that would not interfere with FAA (Federal Aviation Administration) air traffic control operations. AFCRC operated two F-106A interceptors (57-244/245).

Detachment 15 (CMD), Palmdale

The Air Force maintained a detachment at Palmdale, California where F-106s manufactured in San Diego underwent a final fitting-out before delivery. Part of the purpose of the detachment was to complete final preparation for flyaway to an operational squadron.

Dayglo was applied to the tails of QF-106s; their rudders retained squadron markings to avoid control balance modifications.

Air Combat Command

Established only on 1 June 1992, Air Combat Command (ACC) is too recent to have fielded squadrons of manned F-106 Delta Dart interceptors. However, ACC sang the swan song for the F-106 with its drone squadron, which operated the aircraft until late 1997. ACC's 475th Weapons Evaluation Group headquartered at Eglin AFB, Florida is the parent command for the 82nd Aerial Target Squadron at Tyndall AFB and that squadron's Detachment 1, operating at Holloman AFB, New Mexico. The Tyndall and Holloman units employed the QF-106 drone through the early to mid-1990s for a variety of training and exercise missions.

In late 1991, the QF-106A began to replace the QF-100D/F Super Sabre as the USAF's FSAT (full-scale aerial target), first at the White Sands Missile Range, New Mexico and thereafter at the Eglin Gulf Test Range, Florida. The QF-106A is deemed better able to simulate an enemy aircraft for air-to-air missile engagements because of its higher speed and greater manoeuvrability.

As with earlier FSATs, a typical mission employs the QF-106A as a target for an air-to-air test of an infra-red missile and is flown 'nullo' (with no pilot aboard). The QF-106 is controlled by ground operators. The intent is for the QF-106A target drone to survive repeated engagements with air-to-air missiles.

The delta wing of the QF-106A made it impossible for the aircraft to employ the wingtip propane burners used on earlier drones to create an infra-red source for heat-seeking missiles. The burners were placed beneath wing pylons, which are located beneath the wing and rather far forward. This proved less than fully satisfactory, in part because in most test range missile engagements the missile is fired down at the target.

Operation of Delta Darts at Holloman AFB, New Mexico and Tyndall AFB, Florida was managed by General Electric.

Civil contractors

In addition to operating aircraft at Edwards (separate entry), Convair was an 'F-106 operator' at Holloman AFB, New Mexico with three aircraft on bailment. An F-106A (56-460) and an F-106B (57-2514) were operated by the manufacturer at Holloman for armament separation tests. An F-106B (57-2507) undertook supersonic ejection tests.

Three Delta Darts were on bailment to Hughes, manufacturer of the fire-control system, at Holloman. One F-106A (56-457) was used for a general evaluation of characteristics of the aircraft. An F-106B (57-2508) was used to test the infra-red sight and chaff. A third aircraft (serial unknown) was used in engineering support.

The B-1 chase programme

The chase programme for the B-1B Lancer bomber got underway at Palmdale on 10 October 1986 with the arrival of the first chase aircraft, an F-106B (57-2513). F-106s accompanied every production B-1B during its check-out flight from Palmdale prior to delivery of the bomber to the USAF. The chase pilot's job was to provide an outside pair of eyes to spot any external problems on the B-1B about which the bomber's crew might not have known. The first flight of each of the 100 bombers final-assembled at Palmdale was of four hours' duration, requiring two F-106s that switched over at the two-hour mark.

F-106s were used to support test flights from Palmdale and Tinker AFB, Oklahoma. Eight 106s were assigned to the programme: 57-2509, 57-2513, 57-2535, 58-0795, 59-0008, 59-0060, 59-0061 and 59-0149. Initially, these chase aircraft had red tails. In time, black and blue tails also appeared, with a white 'B-1/F-106 CHASE' flash, designed by Jerry Roth, a crew chief with the B-1B programme. Following delivery of the final B-1B the last F-106 chase aircraft, an F-106A (59-0061), ended its role in the programme and departed for the 'boneyard' at Davis-Monthan AFB, on 6 July 1990.

The eight F-106s used for B-1B chase missions from 1986-90 wore a 'B-1/F-106 CHASE' logo.

NACA/NASA

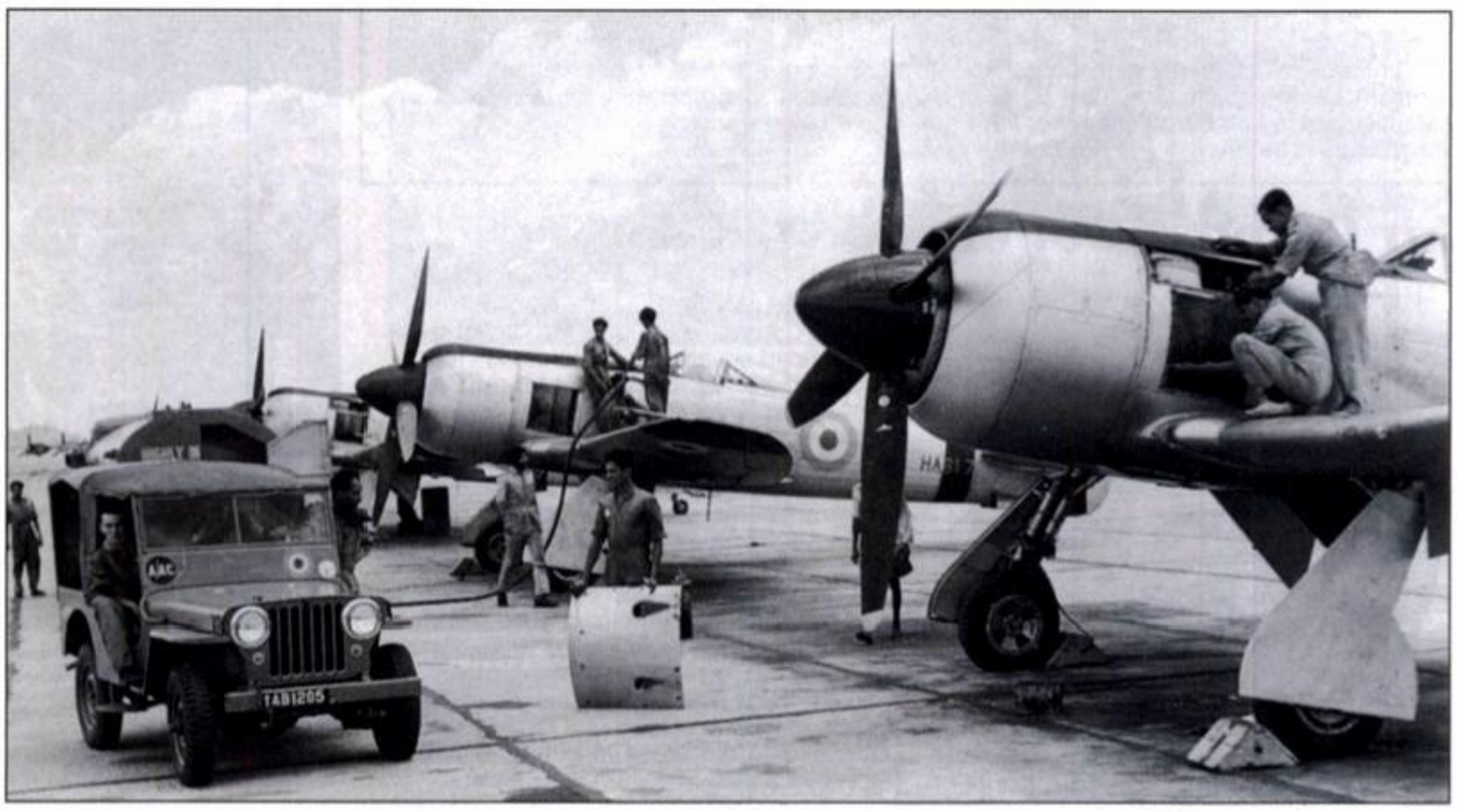
The National Advisory Committee for Aeronautics (NACA) and its successor, NASA (the National Aeronautics and Space Administration), operated examples of the F-106 as early as 1961, when an F-106A joined the Ames fleet for use as an automated control systems test aircraft.

The Dart served almost continuously with NASA for nearly 40 years, supporting a diverse variety of programmes. NASA finished up as the last operator of the type, having employed nine airframes at various times. The busiest of these was NF-106B 57-2516 (NASA 616), which joined the NASA fleet in 1966. The last of the NASA Darts was a former drone, QF-106A 59-0130, used at NASA Dryden in Project Eclipse as the EXD-01.

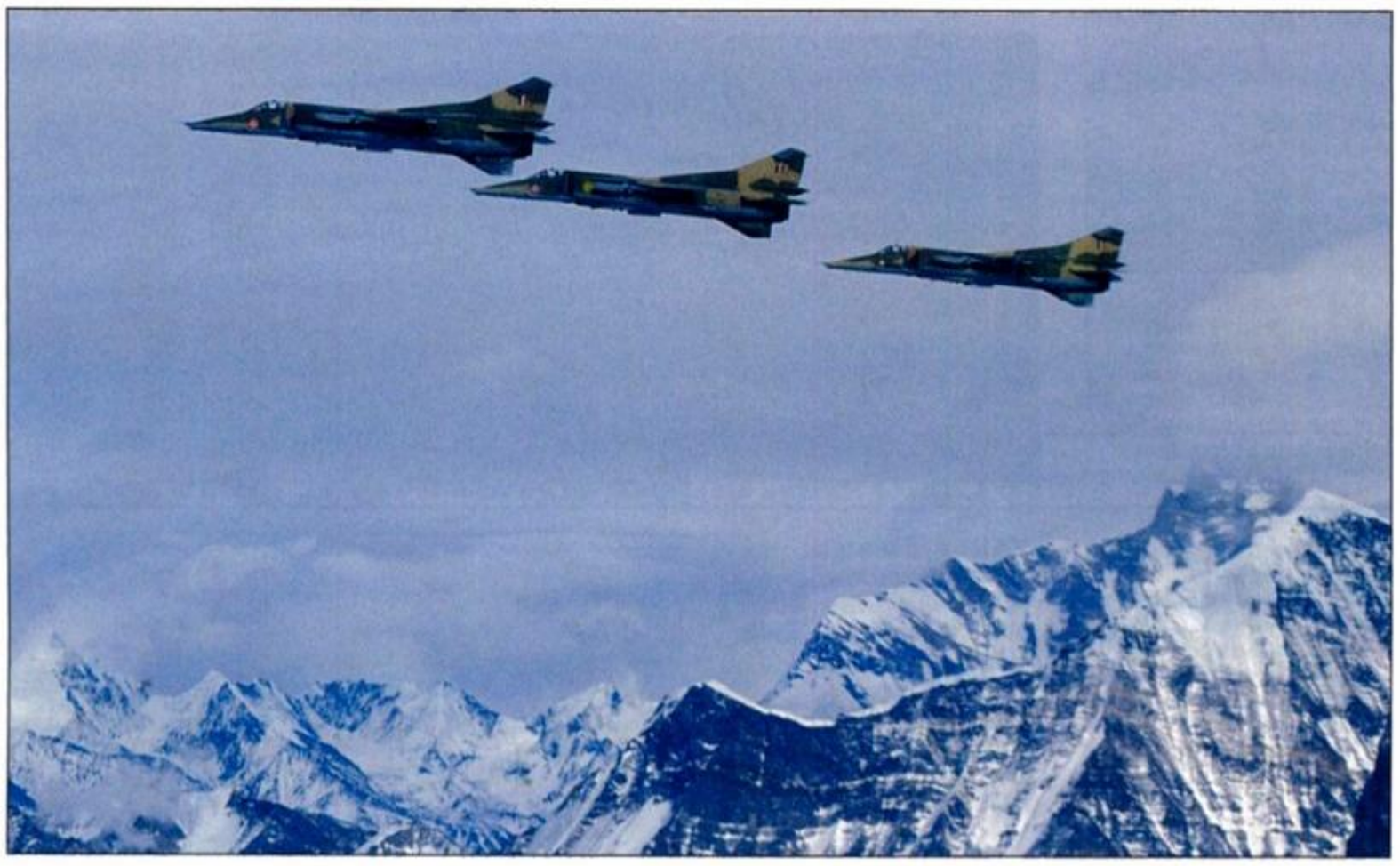
NASA 616 wore a variety of colour schemes during its career with NASA, including this blue/grey one, while fitted with underwing J85 pods from 1966 to 1979.

'Winged Daggers'

The last Indian Air Force unit formed during World War II, No. 10 Squadron has gone full circle: it began life as a fighter-bomber unit, became the IAF's first night-fighter squadron with its first jet aircraft, and returned to ground-attack with India's first locally-designed and -built combat aircraft, the Marut. Blooded in two wars, including the 1971 skirmish with its neighbour Pakistan, No. 10 has lived up to its motto 'Determined to Destroy'. Today it operates locally-built MiG-27s.



No. 10 Squadron, Indian Air Force



No. 10 Squadron of the Indian Air Force, aka the 'Winged Daggers', was the last fighting formation of the IAF to be created during World War II. Along with No. 9 Squadron, IAF, it was formally established on 20 February 1944 at Lahore in the Punjab and equipped with the Hurricane Mk IIC fighter-bomber. The first commanding officer was Squadron Leader R. F. T. Doe, DSO, DFC and Bar, a distinguished RAF officer who set about bringing the youngest Indian Air Force squadron 'up to speed' as rapidly as possible.

Conversion training commenced on 24 March and included formation flying, night operational flying and so on, but not gun-firing exercises because of a lack of facilities. On 10 April the nascent squadron took part in an air display as part of the War Services Exhibition at Lahore and a month later, on 10 May, moved northwest to Risalpur, continuing with training there until the end of June 1944.

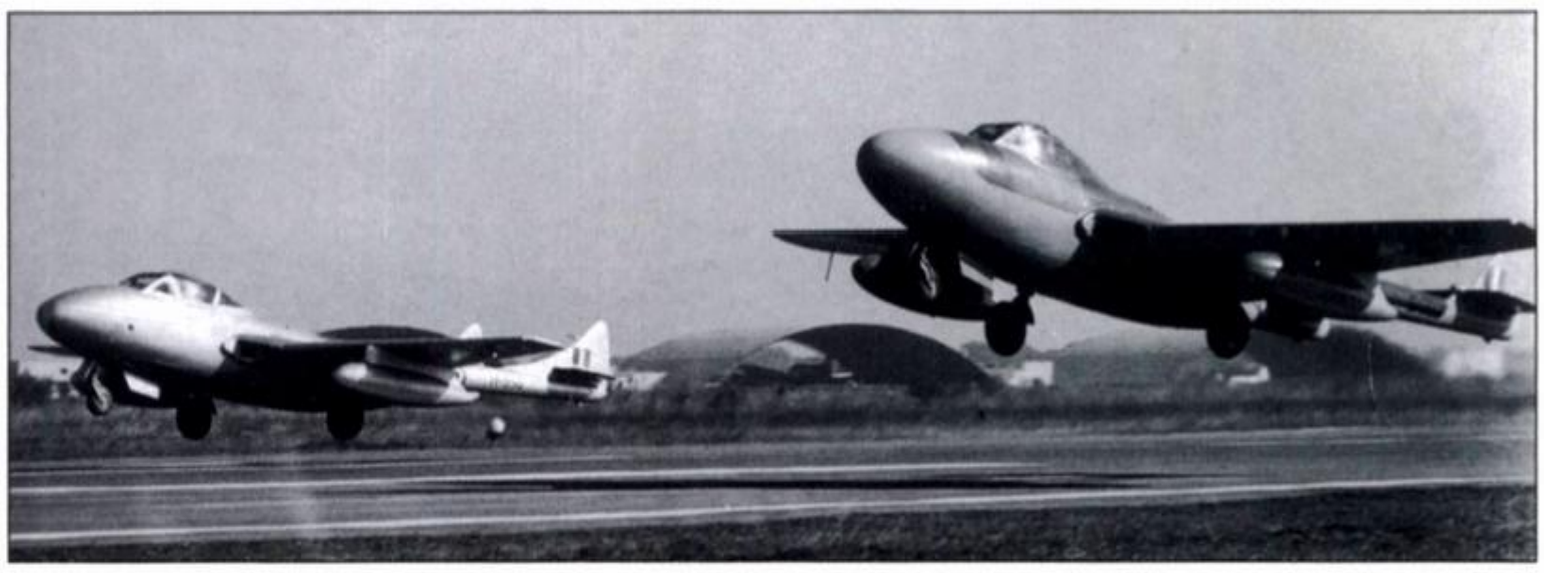
The move to the east, and the war against Japan, began on 1 July, first to Amarda Road where No. 10 Squadron carried out an air-armament course from 6 to 22 July. On 23 July, the squadron left for its new base at Chhara, staying there for the next four months, with a flight detached to Salbani and then to Dhubulia in the company of B-24 Liberators of the RAF and USAAF. At Chhara, the first flight carried

HAL-built Mikoyan-Gurevich MiG-27MLs, like these aircraft seen over the Himalayas, have equipped No. 10 since late 1993 and are expected to do so into the 21st century.

Above: HAL HF-24 Maruts Mk 1s are seen here, including two two-seat Mk 1Ts. By the time of the December 1971 war with Pakistan, three IAF units operated the type – Nos 10, 31 and 220 Sqns.

Left: Hawker Tempest Mk IIs undergo servicing at Barrackpore, near Calcutta. British fighters equipped No. 10 from its earliest days until the arrival of the first HAL Maruts.

Right: Two-seat Vampires – a T.Mk 55 trainer and an NF.Mk 54 night-fighter – of No. 10 Squadron lift off from Palam. ID592 (right) was the first of the IAF's Vampire 'interim night-fighters', having been refurbished from ex-RAF NF.Mk 10 WM724.



out normal flying exercises, including low-level cross-country flights, quarter-attacks, etc., while the second flight at Salbani carried out affiliation exercises with the B-24 Liberator squadron also based there. Air-to-ground and air-to-sea firing were carried out at the Ranchi and Ramnagar, ranges, respectively, until the end of October.

In November 1944, No. 10 Squadron was given an air-to-ground role as a 'Hurri-bomber' squadron, its aircraft being fitted with bomb racks to carry two 250-lb (114-kg) or 500-lb (227-kg) bombs under each wing, at Agartala. The squadron practised high-level shallow dive-bombing at Ranchi during that month, and early in December 1944 No. 10 moved to Ramu in the Arakan for war operations.

The Third Arakan Campaign began in earnest in December 1944, the Allied objective being to capture the Mayu Peninsula, Akyab and Ramree Island, in support of the XIV Army advancing along the Irrawaddy valley. The campaign was a continuous series of combined operations, the Navy and Air Force supporting the Army throughout the four months. This theatre saw the strongest concentration of Indian Air Force squadrons, six of the nine in existence being engaged. No. 10 Squadron commenced operations from Ramu on 23 December 1944 and continued in action until 18 April 1945, priority in air support being initially given to the 81st West African Division during the Kaladan Valley campaign. Disrupting the Japanese communication system was the squadron's special assignment, targets being bridges, ferries and jetties in this area. In one attack, 14 250-lb (114-kg) bombs landed on the Mychaung jetty, and Paungdok bridge was destroyed. Through the greater part of January 1945, No. 10 Squadron continued in support of the 81st West African Division, all 12 of its 'Hurri-bombers' operating from an advance airstrip at Paukpingwin to cover a brigade advance over open country. A hill feature east of Teinnyo was bombed accurately and Japanese hill villages attacked relentlessly.

Pathfinding for Liberators

Some days later, three IAF 'Hurri-bomber' squadrons (Nos 4, 9 and 10) were deeply committed in the Kangaw area, operating under extreme pressure during some of the fiercest fighting in the Arakan. The squadron attacked concentrations of Japanese troops in Kangaw village and, on the day of the main assault, 12 aircraft of No. 10 Squadron led 48 B-24 Liberators to the target area as pathfinders, their target indications being reported as 'excellent'. In early February 1945, No. 10 Squadron flew in direct support of 74 Infantry Brigade which had crossed the Min Chaung, until the Japanese forces were finally beaten. As a senior Army officer said, "Without the Indian Air Force, I do not know what we would have done or achieved."

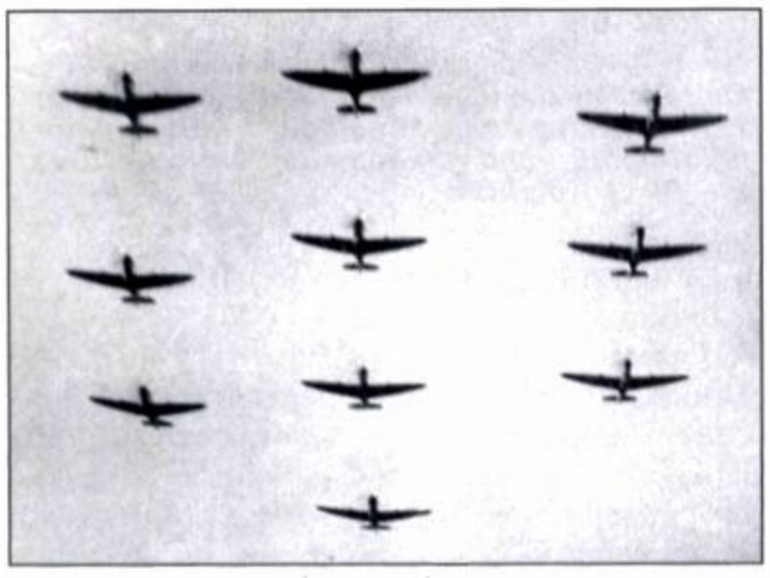
No. 10's 'winged dagger' emblem was officially approved by the President of India in December 1955, when the unit was equipped with Vampire night-fighters and was sometimes referred to as the 'Black Knights'.

For the later part of February and into March, Nos 3, 4, 9 and 10 Squadrons, IAF concentrated their efforts on interdicting the Japanese communication system, strafing and dropping bombs, and destroying bridges, with great accuracy. No. 10 Squadron used Akyab as forward base on the day of the landing, having moved to Bawli Bazar and then Kyaukpyu in early March to be nearer the area of operations. No. 10's aircraft bombed and strafed Japanese

Above: Tropicalised IAF Hurricane Mk IICs are seen at Risalpur in 1944. No. 10's 'Hurri-bombers' flew close air support sorties from late 1944, during the Third Arakan Campaign.

Left: F/O Moolgavkar (Chief of Air Staff, 1975-77) waves to his dog Tuck from the cockpit of his Hurricane during the Arakan Campaign, 1945.

gun positions, jetties, rivercraft and ferries, and also flew counter-battery patrols, often to the limits of their radii of action. Some of the positions bombed were a mere 100 yd (91 m) from the forward Allied troops and great accuracy had to be maintained. On 29 March, No. 10 Squadron's 'Hurri-bombers', escorted by six Spitfires of No. 273 Squadron, RAF, bombed an ammunition dump east of Taungup, following up with attacks on Japanese wagon lines and watercraft on the Taungup river. Japanese defensive positions were sited in thick jungle and No. 10 Squadron began to use incendiary bombs which cleared wide stretches of forest. Counter-battery patrols, incendiary bombing and gun attacks against bashas, gun positions and rivercraft characterised No. 10 Squadron's activities. The Taungup–Prome road was a vital link for the Japanese on the central and Arakan fronts, and No. 10 Squadron was engaged in road-busting missions in late March, as many as 36 sorties being flown on 31 March alone.



Spitfire Mk VIIIs were issued to RAF and IAF units in the Burma-India Theatre from late 1943. No. 10 Squadron received its first Mk VIIIs in July 1945.

Royal Indian Air Force

The Indian Air Force had played a great part in the Burma campaign, flying more than 16,000 operational sorties. The arm had the designation 'Royal' bestowed on it in March 1945 in recognition of its distinguished record.

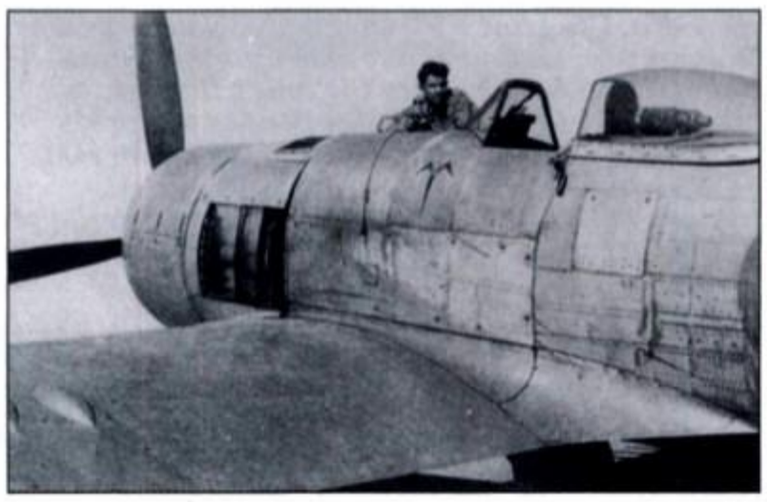
The shooting war was over for No. 10 Squadron, which left for Yelahanka (near Bangalore in South India) in the fourth week of April 1945. Earmarked for conversion to Spitfires, the squadron moved to Trichinopoly in early May but then had to wait until mid-July until the first Spitfire VIIIs were received. All the squadron pilots had completed 15 hours of flying on the Spitfire by early September and were declared 'fully ops' when No. 10 Squadron was moved back to Burma, this time under command of Squadron Leader R. W. Jones, RAF. However, by November, all non-Indian personnel were posted out; No. 10 Squadron became an all-Indian unit on 5 January 1946 when Squadron Leader H. Raza assumed command. Earlier, No. 10 Squadron, with 14 Spitfire VIIIs and one Harvard, had left Trichinopoly for Ulandert and then Hmawbi in Burma, where they remained until 15 February 1946. In a unique all-IAF event, 36 Spitfires of Nos 8, 9 and 10 Squadrons took part in a formation flypast in January 1946 while a detachment of six Spitfires of No. 10 Squadron escorted the Supreme Allied Commander, Lord Louis Mountbatten, to Bangkok on 18 January. The next day, No. 10 mounted a flypast for the King of Siam.

The squadron returned to India in February 1946 and was to be based at Chakeri (Kanpur) where, six months later on 20 August 1946, Squadron Leader Rehman took over command. A significant date was 9 May 1947, when Squadron Leader H. Moolgavkar (who in 1975 became Chief of Air Staff, Indian Air Force with the rank of Air Chief Marshal) became CO of No. 10 Squadron, which then proceeded to convert to the Hawker Tempest Mk II during the same month. Barely three months later, No. 10 Squadron was detached to various airfields as an aid to civil authority during the tumultuous months preceding, and following, India's partition and independence in August 1947. Led by Moolgavkar, No. 10 Squadron, RIAF had the distinction of mounting the first formation flypast of independent India, with six Tempest Mk IIs flying over the National Stadium in New Delhi when Jawaharlal Nehru, India's first Prime Minister, took the salute at a combined armed forces parade. The next day, 16 August 1947, the flypast was repeated over the historic Red Fort in old Delhi.

Reconnaissance over East Punjab

September saw the squadron Tempests employed for reconnaissance work over the East Punjab areas, where literally millions of displaced people were fleeing from the newly formed Muslim State of Pakistan.

On 22 October 1947, the State of Jammu & Kashmir (J&K) was invaded by a large number of tribal lashkars from across the border in Pakistan, their objective being to capture the Vale of Kashmir, move on to the Banihal pass, cutting off Srinagar from the south, to capture Poonch and Rajauri and, eventually, Jammu itself. On 26 October, when the tribal hordes were barely one day's march from the capital,



Above: This Tempest Mk II is adorned with the first 'winged dagger' emblem applied to a No. 10 Squadron aircraft.

the Maharaja of Kashmir fell into line with the Indian government; at dawn on 27 October 1947, elements of the 1st Bn Sikh Regiment were airlifted to Srinagar in RIAF and civilian Dakotas. They went into action almost immediately upon arrival. In the ensuing days, a stream of Dakotas flew in an advance HQ for 161 Brigade to Srinagar, with some mountain guns, but the situation remained precarious until 7 November when Indian troops, supported by the RIAF, launched a counter-offensive, routing and dispersing the enemy. 161 Brigade pursued the fleeing raiders, rapidly recapturing Baramula, Mahura and Uri. RIAF aircraft, primarily Tempests from Amritsar, strafed and rocketed the enemy and even flew offensive sorties against targets up to Muzzafarabad.

Action in Kashmir

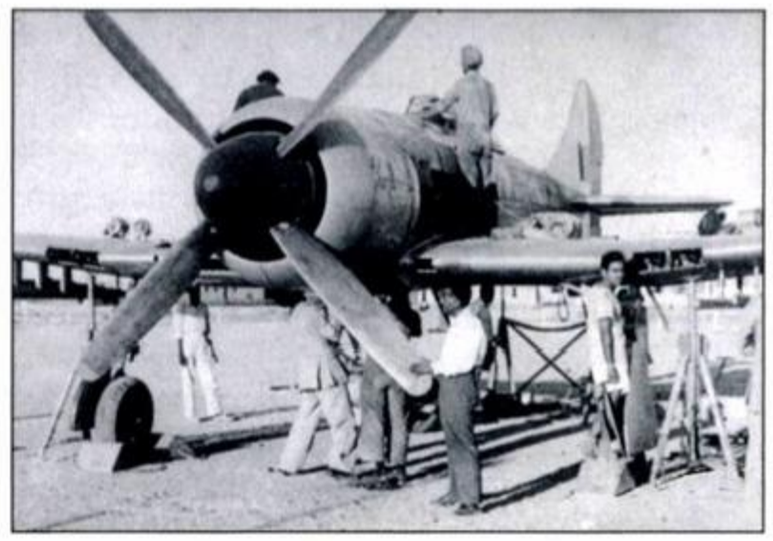
The tribal invasion of Kashmir had meant an immediate move of No. 10 Squadron to Ambala. From 2 November 1947, No. 10 Squadron's Tempests were deeply involved in the J&K operations, providing close air support to the Army and carrying out rocket and bombing attacks against enemy lines of communication, bridges and defence positions. Operating initially from Ambala and Amritsar airfields and later from the forward airstrips at Jammu, and eventually from Srinagar itself, the squadron carried out bombing, strafing, rocket attacks, offensive sweeps and armed reconnaissance, with over 300 operational sorties flown, 500 rockets fired, 20,000 lb (9072 kg) of bombs dropped and 26,000 rounds of 20-mm cannon fired.

Three RIAF Tempest squadrons (Nos 7, 8 and 10) were committed in Jammu & Kashmir for the next 12 months, flying armed reconnaissance patrols, offensive sweeps, interdiction sorties and close air support of the army in various theatres. In December 1947, when the siege of Poonch began, hostile positions were engaged by rocket and cannon attacks of RIAF Tempests. The airstrip at Jammu had been readied for operational flying and No. 10 Squadron moved to this location from Amritsar, taking part in operations in the Akhnur-Chhamb area and thereafter in the Naushera sector. The capture of Rajauri saw No. 10 Squadron's Tempests in strenuous action, supporting 19 Infantry Brigade's three-fold thrust, led by Sherman tanks of the Central India Horse Regiment. Major General Kalwant Singh, GOC JAK Force, sent a personal letter of congratulations to No. 10 Squadron for the excellent support. The CO, Squadron Leader H. Moolgavkar, was awarded the MVC for gallantry and, on promotion, handed over the unit's reins to Squadron Leader Z. A. Shah, who commanded it through the rest of the operation. Jhangar was fiercely contested in the early months of 1948 and, in May, 19 and 80 Infantry and 50 Parachute Brigades fought numerous enemy formations, including regular Pakistani army troops, being supported throughout from the air.

By mid-1948, eight infantry brigades were operating in Jammu & Kashmir and two Divisional HQs were established. Sri. Division (19th) was in the valley, ensuring the complete security of Srinagar, securing the communications to Skardu, Leh and Kargil, while the JA Division (26th) was responsible for the Jammu area. By the end of May 1948, Tithwal was

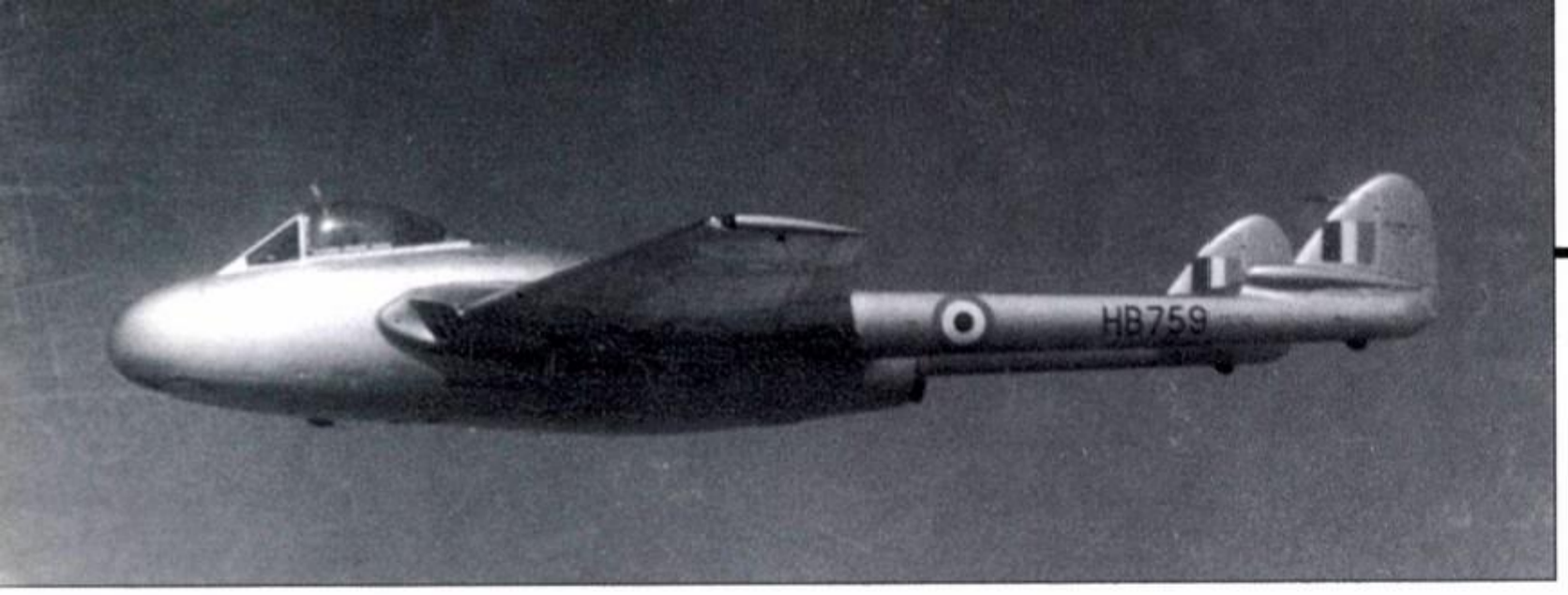
Above: An RAF delegation inspects No. 10 Squadron's Tempests at Halwara (Punjab).

Right: Steadied on trestles, a RIAF Tempest undergoes cannon harmonisation.



Right: Flt Lt Dilbagh Singh and F/O Umed of No. 10 Squadron consult a map before a sortie.

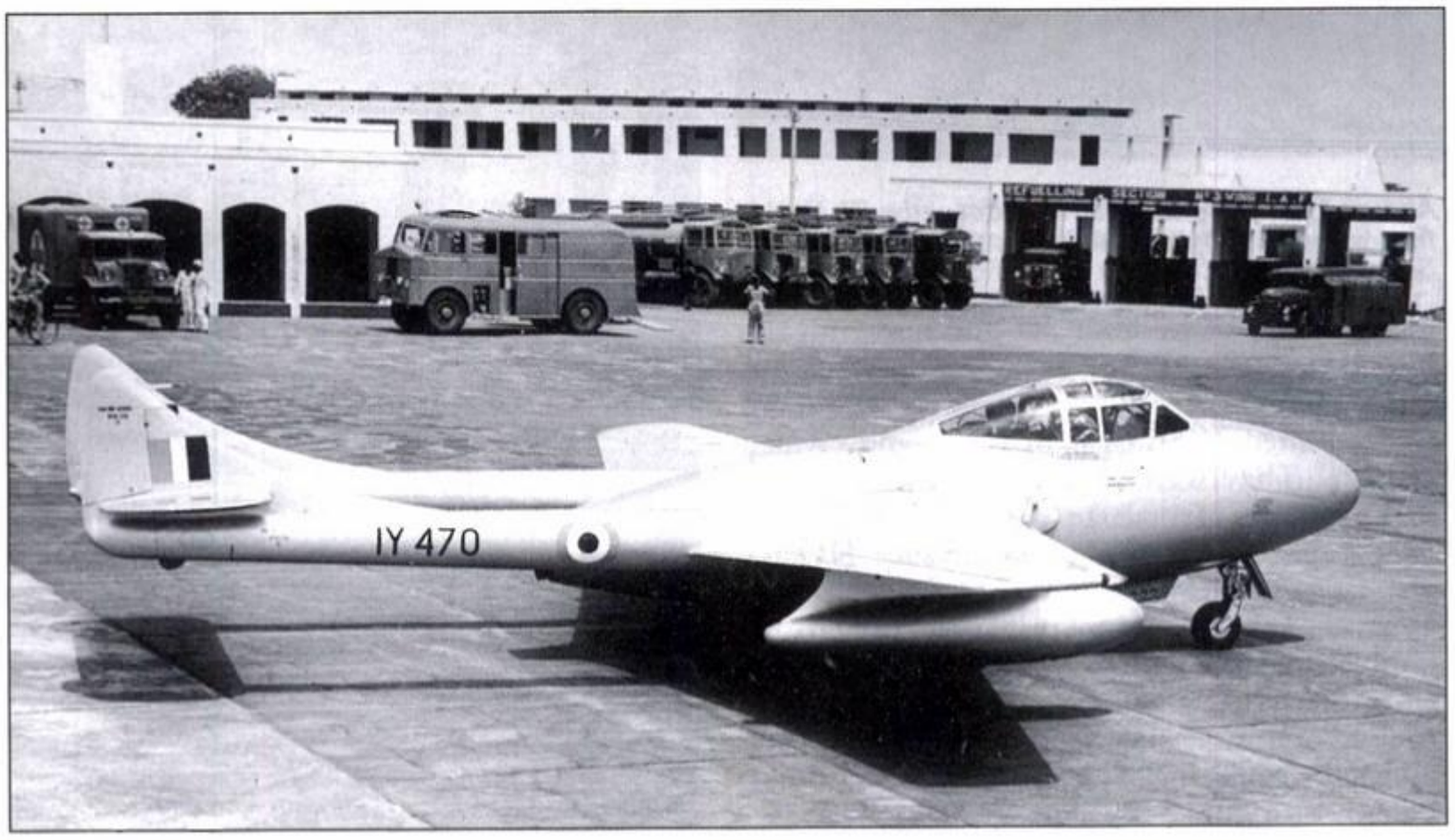
Below: In pristine condition soon after delivery, HA595 (formerly MW386 in RAF service) poses for the camera at a base in India.



Left: No. 10's stint with single-seat Vampires was a short one, lasting about nine months. These Vampire FB.Mk 52s were the unit's first jet aircraft, the IAF taking delivery of 39 examples built by de Havilland, followed by 247 from HAL.

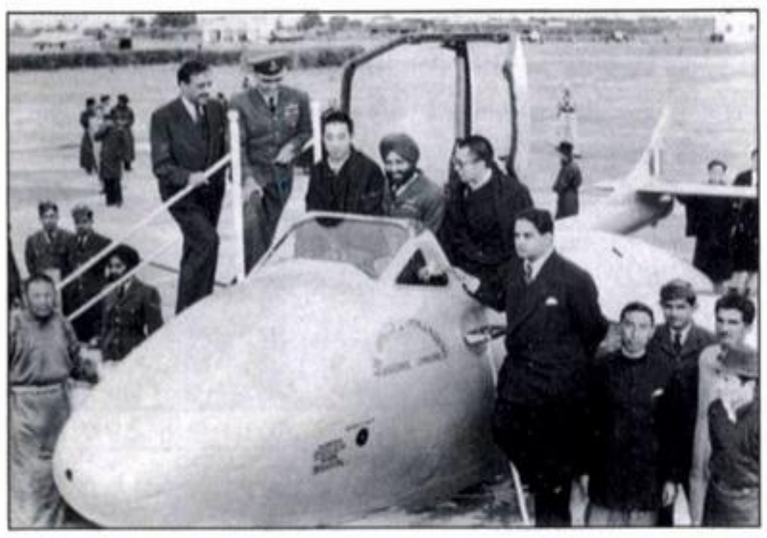
Below: IY470, from the first batch of four Vampire T.Mk 55s, arrives at Palam in 1954. Note the early design of the framed canopy.

Air Marshal Sir Gerald Gibbs, RAF poses in a No. 10 Squadron Vampire in 1954, during his secondment to the IAF as its Chief of Staff.



finally captured by 163 Brigade, while 161 Brigade attempted to advance past Uri, towards Domel. No. 10 Squadron had moved to Srinagar and was able to fly continuously in support of the advancing troops, who faced very stiff resistance from regular Pakistani army brigades and heavy artillery concentrations. Further south, the relief of Poonch and its besieged 101 Infantry Brigade was under way, with 269 Brigade advancing steadily. Enemy positions at Pir Badesar and Paran were softened up with rocket attacks by Tempests. Later, in October 1948, Ramgarh fort and Bhimbar Gali were captured by 5 and 19 Infantry Brigades.

The Tempests flew many counter-battery missions in the Tithwal and Uri sectors, attacking hostile 25-pounder gun positions but also facing intense AA fire from 3.7-in heavy anti-aircraft guns and 40-mm Bofors, some aircraft being hit and lost. Enemy artillery in the Chakothi area was particularly active and RIAF Tempests engaged the 5.5-in medium gun positions with rockets, especially in early September 1948.



Above: Visiting Tibetan dignitaries, including the young Dalai Lama, pose in the cockpit of a Vampire T.Mk 55 with Air Commodore Arjan Singh, DFC, then AOC Operational Command.

'Real time' congratulations

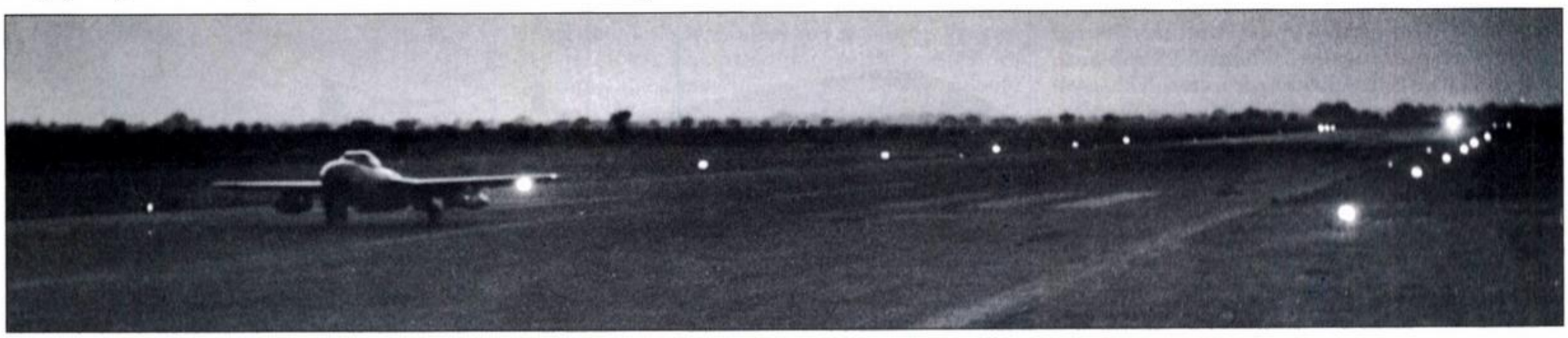
No. 10 Squadron provided close air support for advancing troops with the aid of a Visual Control Pilot (VCP), and the pilots were congratulated 'real time' on the R/T by the Brigade Commander, Brigadier Umrao Singh. The Tempests also carried out bombing attacks against the enemy brigade headquarters and rear echelon areas, the squadron being later visited by Air Commodore AM Engineer and Lieutenant General Srinagesh for personal congratulations on the extremely accurate attacks.

77 Parachute Brigade's spectacular advance to, and capture of, the Zojila pass and subsequent advance to Kargil and Dras was continuously supported by the RIAF in November 1948, the Tempests rocketing hostile defence positions and strafing the retreating enemy until the Leh garrison was firmly linked on 24 November 1948.

The UN-sponsored ceasefire came into effect on 31 December 1948, but No. 10 Squadron had already moved out of the state in October. It was to be located at Palam airfield, Delhi with its Tempests for the next two years, along with Nos 7 and 8 Squadrons and No. 101 PR Flight. Squadron Leader C. G. Devasher became CO on 10 May 1949, handing over briefly to Squadron Leader G. K. John and then Squadron Leader P. W. Pawar in August 1950. In 1950, the squadron moved detachments to the Punjab and Rajasthan to counter belligerent moves by Pakistan and then, in 1951, moved east to Barrackpore north of the great city of Calcutta. Bellicosity by Pakistan, again, in early 1952 saw No. 10 Squadron moving to the north of India, the Tempests being based at the new airfield at Halwara, near Ludhiana in the Punjab from April 1952. On 18 July of that year, Squadron Leader G. K. John again took command of No. 10, handing over to Squadron Leader C. H. I. Digby in October 1953.

December 1953 was a significant month as No. 10 finally relinquished its Hawker Tempests Mk IIs, moving to Palam and into the jet age, converting to the de Havilland Vampire FB.Mk 52 in the fighter-bomber role. This was, however, to be a short stint, as in August 1954

A a No. 10 Squadron Vampire NF.Mk 54 lands at dusk after a training sortie. During the action to liberate the Portuguese enclaves of Goa, Daman and Diu in December 1961, No. 10's Vampires undertook pre-dawn and dusk CAPs over Goa.



Above: A flight of Vampire Mk 54s is seen over the Indian capital, New Delhi, sometime in 1956.

Right: Vampire Mk 54s are seen on parade at Palam in 1958. The third aircraft carries a 'winged dagger' badge, while No. 20 Squadron Hunter Mk 56s can be seen in the background.

No. 10 Squadron was selected to become the IAF's first dedicated night-fighter squadron, receiving the two-seat Vampire NF.Mk 54. Under the command of Squadron Leader David Bouche who was to be 'boss' for the next three years, the squadron was based at Palam for all-weather air defence of the capital. This was to be the longest continuous period No. 10 had spent at the same station so far; the unit remained at Palam, equipped with the Vampire NF.Mk 54, for the next 10 years.

The first aircrews were trained for night-fighter operations with the Royal Air Force in the UK but subsequent pilots and navigator/radar operators were qualified on type in the squadron, which had also received T.Mk 55 trainers.

Dakota trainer

No. 10 Squadron had a number of unique features: it was the only fighter squadron in the IAF to have an equal number of navigators on strength as it had pilots, and was the only fighter squadron to include a Dakota on its inventory. The Dakota was specially equipped in the UK with radar in a radome nose for training navigator-radar operators (nav-rads) in the night-fighter squadron. The aircraft (HJ879) was nicknamed variously as 'Nosey' or 'Cleopatra' or the 'Parsi-Dak'.

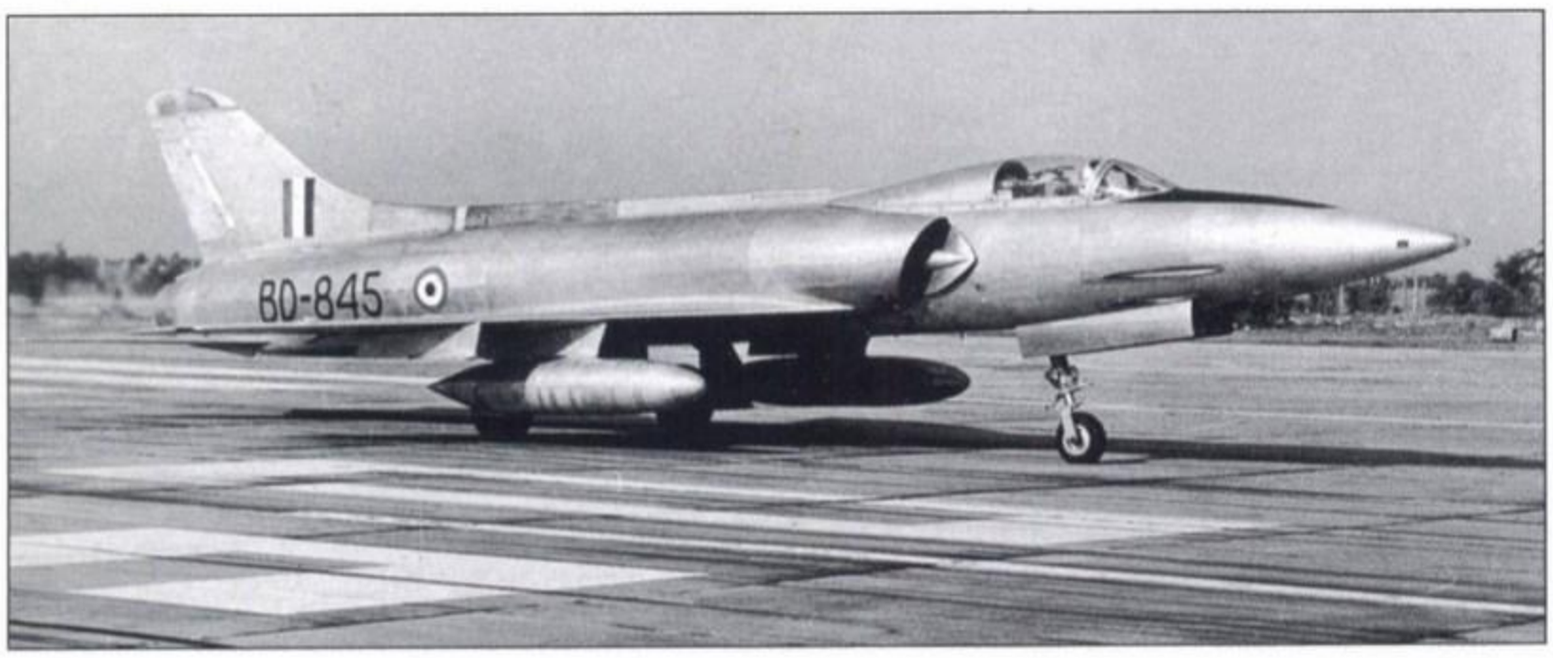
The Vampire night-fighters carried out GCI exercises and practised night-fighter tactics continuously, with No. 11 Signals Unit controlling them. No. 10 Squadron was affectionately named 'Black Knights' because of their nocturnal activities even though the squadron's emblem, the 'winged dagger', was formally approved by the President of India on 20 December 1955.

With their Vampires in the background, No. 10 Squadron aircrew amble along to their debriefing after a sortie in January 1956. Third from left is unit CO, Sqn Ldr David Bouche, with Flt Lt (later Air Marshal) 'Chandu' Gole on his left.

Squadron Leader S. R. Powar assumed com-

de Havilland DH.113 Vampire NF.Mk 54

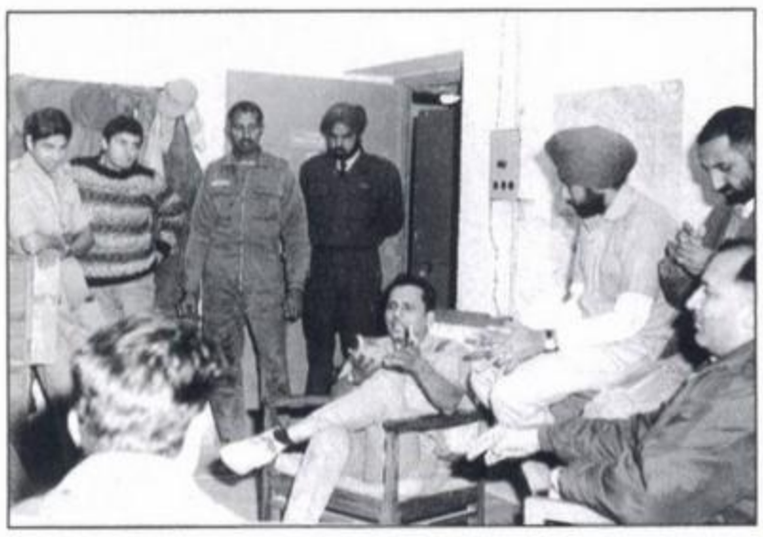
ID605 was converted from ex-RAF Vampire NF.Mk 10 WM675 and included in a batch of 18 Mk 54s delivered in 1954 for use by No. 10 Squadron at Palam. Though an 'interim' type, the Vampires soldiered on for 10 years with the squadron; rumours that they would be replaced by Gnats in 1963 proved to be baseless.



BD-845 was the second production HF-24 Marut (Wind Spirit) and among the first batch of Maruts delivered to No. 10 Squadron.

mand on 7 July 1957. On 23 December 1957 the unit was split, with aircrews and some Vampire NF.Mk 54s being 'milked' to create a new night-fighter squadron, No. 37, with whom it shared the base at Palam before the latter moved to Poona two years later. Squadron Leader Y. K. Barman became CO of No. 10 Squadron on 1 September 1959, after a stint of instructing in Egypt. Flight Lieutenant 'Chandu' V. Gole, who had joined the squadron in 1955 and been senior flight commander, was selected for the ETPS course in the UK, and thus blazed the trail for more pilots from No. 10 Squadron to become test pilots, being followed in due course by 'Babi' Dey, 'Chuchu' Tilak and 'Granny' Dhiman.

'Chandu' Gole was to have a brilliant, if chequered, career in the Indian Air Force, rising to the rank of Air Marshal, becoming Deputy Chief of Air Staff, AOC-in-C South Western Command and, after retirement, Chairman of the Airborne Surveillance Warning and Control (ASWAC) project. He served with No. 10 Squadron in the early years and related some interesting memories.



Left: Staff discuss the day's events in the crewroom at the forward base at Uttarlai during the December 1971 war with Pakistan.

Below: Officers and men of No. 10 pose with a pair of Maruts. The camels were used to patrol the perimeter at Uttarlai on the edge of the Great Indian Desert, or the Thar.

"In July 1955, No. 8 Squadron, my previous unit, had just returned after three months of armament training at Jamnagar. It had been the first squadron to be equipped with the French Ouragans (later christened 'Toofani' by Prime Minister Nehru). The aircraft had yet to achieve full operational clearance, so the armament exercises had the potential for some unpleasant surprises. However, in spite of teething problems, the squadron had done well and set a few records. The boys were now awaiting subsequent 'goodies', such as being assigned to specialist courses like the pilot attack instructors (PAI), fighter leaders, etc. I was then the flight commander and had been officiating as squadron commander for two months when an unexpected posting signal appeared on my table. I was to report as adjutant of No. 10 Squadron, which had just converted to Vampire night-fighters. As the first dedicated all-weather fighter squadron of the IAF, No. 10 was assigned the task of air defence of Delhi by day and by night, a glamorous-sounding task! But the aircraft were of an earlier vintage and rumours had it that perhaps the twin-engined Gloster Meteor night-fighter would have been a better choice. So one was not quite sure whether the adjutant posting was a 'goodie' or a come-down for a person who had already been flight commander in two front-line squadrons, Nos 1 and 8, and that before the age of 27 years!

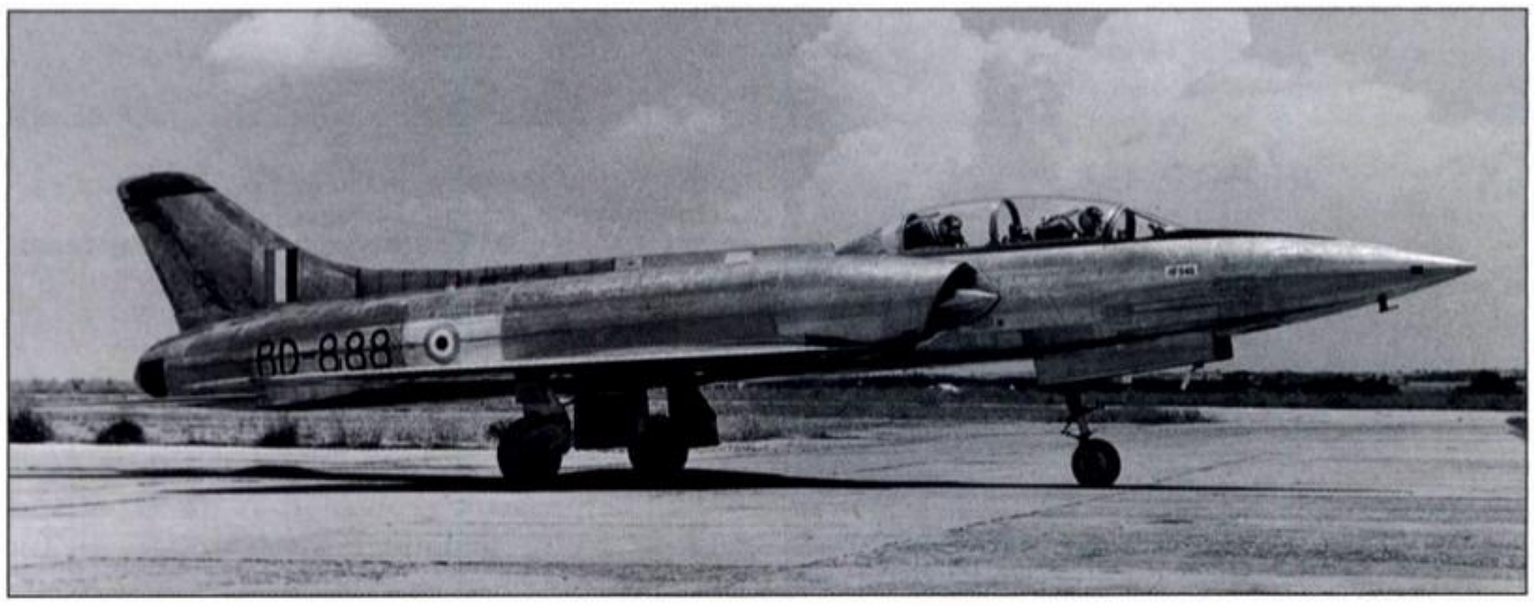
'Chandu' Gole joins No. 10

"I drove from Ambala to Delhi in an ambivalent state of mind and presented myself to the CO of No. 10 Squadron, Squadron Leader David ('Boss') Bouche, well known not only for his flying skills but also for his physical prowess (though less than his brother John, who was known to spar with trees when he had no human opponent!). 'Boss' twitted me for having tried to stall my posting. Night-fighting, he explained, was a very specialised role and great care had been taken to select the best pilots. He was sure that I would change my earlier misgivings after some 'education'.

"No. 10 Squadron had been stationed off and on at Palam since the days of partition in 1947 and had come back to Palam in 1954 to convert to the Vampire night-fighters. Headquarters were housed in two small wartime barracks, each with four rooms and two small end-cubicles. The first barrack housed the commanding officer, the adjutant, the flight commander and the nav. leader, and also the crew room.

"No. 10 Squadron flew mostly at night. The working hours therefore were from 17.00 to anything between 01.00 and 04.00, and in the morning from 09.00 (a special concession) to 13.30. A minimum of four days of night-flying entitled the squadron to take Saturdays off, if there was no pending work. One did not know how the days went, or, more importantly, how the nights went. No cinema, no dating, no radio, no drinking for five days a week. On the sixth day, one was generally too tired! That left only Saturday nights and Sundays for horsing around. The only concession given to the crew as relief from this gruelling routine was that they were not to be given any secondary duties like being orderly officer, conducting courts of inquiry, etc. Even this concession gradually eroded, and none was evident by 1957.

"However, the exclusive night-flying role was quite an education and experience. To be



Above: Maruts served the IAF into the early 1980s. Plans to build a Mach 2-capable variant with afterburning engines were abandoned.

Right: Marut Mk 1T dual-control conversion trainers joined No. 10 from 1975, supplanting the Hunter T.Mk 66s used hitherto.

flying alone, high up when the world below was asleep, where the moon and stars looked so exquisite and clear that you could even see the shadow of your hand on your knees on dark nights – sheer exhilaration! To keep track of your position purely by mental DR (dead reckoning) and with some help from the ground air defence radar (very primitive in those days), one had to learn to recognise villages and towns by street-light patterns – which invariably were switched off by midnight. Take-offs and landings were along a single line of flares (goose-necks) to simulate operational conditions. One learned to discern and identify roads, railway lines, rivers and canals even in no-moon conditions; it is amazing how much starlight can help. In fact, we got so used to the dark night conditions that we preferred those to moonlight which, picturesque as it was, affected one's depth perception.

Vampire apprehensions

"In flying night-fighter aircraft, there was always a lurking apprehension about the consequences of any aircraft problems in flight, the worst ones being a fire or an engine failure. The Vampire night-fighter was a modified version of the two-seater Vampire trainer, with no ejection seats but a 'well-type' canopy with side walls and a hinged top. To make room for the airborne interception (AI) radar, the operator's seat was pushed down and back. It was non-adjustable except by whatever cushions/pads one carried. The poor nav-rad had to stretch his neck to just about get a glimpse of the outside world. If it became necessary to abandon the aircraft in an emergency, the pilot had to invert it (climbing out in the airstream was almost impossible), release the canopy top, push it, warn the nav-rad to disconnect his oxygen and radio plugs, tap on his knee as a signal to release straps and 'bunt' the aircraft to help him drop out of the cockpit, wait for three seconds, then repeat the procedure for himself. A very difficult process, to say the least. Thanks to the excellent maintenance crew, throughout the service life of the Vampire night-fighters in the Indian Air Force there was only one instance (fire in the aircraft) when the crew had to abandon aircraft. Neither of them survived, as expected.

"In the initial stages there was no special facility for training a nav-rad except by directly taking him up in a night-fighter, until a modified Dakota became available for simulated airborne radar training. The senior navigator or instructor would give ground demonstrations on a workshop rig, but thereafter the trainees were launched on their own, to learn by hit-and-miss procedures. The training of new nav-rads was always an exciting, if risky, business.

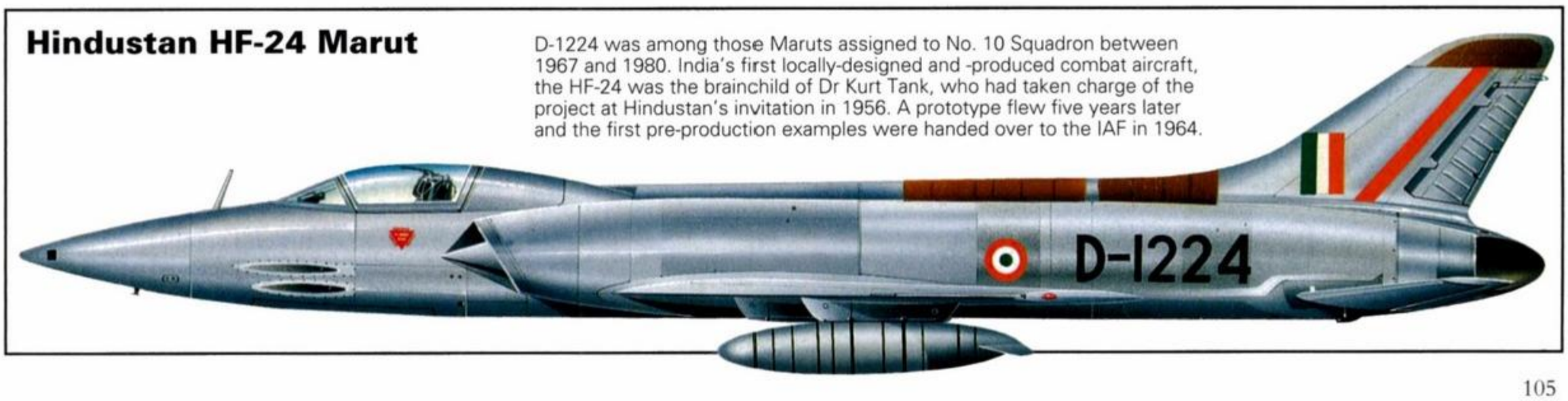
"In one such case, having ordered a closing speed of 30 kt in the final stage, my young nav-rad got tongue-tied as he saw the fast-approaching target on his scope and forgot to warn me. I had, perhaps, allowed things to go too far in trying to teach him a lesson. I pulled up just in time to avoid ramming the target. I felt my aircraft heave as I grazed past the target. The young navigator was so shaken up that he decided to quit night-fighters then and there. It took great persuasion to get him to change his mind. Finally, he did make the grade and went on to retire as a very senior officer. That was the closest that I came to a disaster throughout my stint with the 'Daggers'.

"Great credit was owed to the meticulous and rigorous training and the discipline instilled by night-flying pioneers like Bouche and the first flight commander, Jackie Pawar.

"A word about the weather. The standard of night-fighter boys and their flying skill was considered so high that the normally extremely weather-conscious Air Headquarters had left the decision on 'fly-worthy' weather at night entirely to the squadron commander. The result was occasional thrills or panic – or both – if the CO's weather assessment was not quite accurate. Once on a drizzly night, Flight Lieutenant 'Chuchu' Tilak and I went up to practise some interceptions above the cloud tops, which were supposed to be at 6,000 ft. No thunder clouds were forecast. We got airborne and entered cloud at 2,000 ft and came out in a brilliant, dazzling moonlight, but at an altitude of 20,000 ft and in a gap between two huge thunder clouds. Formation flying in cloud at night can be very disorienting, with the 'fish-bowl' effect from the wingtip navigation lights on which the No. 2 has to formate. 'Chuchu', skilled pilot that he was, hung on to my wingtip without any trouble. As we were being set up for practice interceptions, one aircraft acting as target and the other as the interceptor, flying control intervened, passing on the CO's orders to return to base immediately as heavy showers were predicted. So back into the murky clouds and a controlled descent under the guidance of the radar controller, Flight Lieutenant 'Gaik'

Hindustan HF-24 Marut

D-1224 was among those Maruts assigned to No. 10 Squadron between 1967 and 1980. India's first locally-designed and -produced combat aircraft, the HF-24 was the brainchild of Dr Kurt Tank, who had taken charge of the project at Hindustan's invitation in 1956. A prototype flew five years later and the first pre-production examples were handed over to the IAF in 1964.



India was immensely proud of the Marut and its achievements, giving it pride of place in air displays and even equipping an IAF display team with the type.

Gaitonde, in whom we had implicit faith, only to come out into heavy rain at 1,500 ft. Landing in these conditions was tricky enough, but the bigger problem was that we still had substantial fuel in the drop tanks, far more than was permissible for landing. After all, we had been airborne for only 45 minutes in an aircraft which could stay up for over three hours. Back came the orders to climb up again and finish the exercise – which we did; but only to be hustled back to take advantage of a slight break in the weather. All went well. The end result was a two-hour 15-minute sortie with two practice interceptions and four trips up and down through a thick continuous blanket of clouds,

Low- and medium-level bombing, Tac/R and rocket/strafing attacks were among the tasks with which No. 10's Maruts were entrusted during the December 1971 war with Pakistan.

something unheard of for day-fliers."

The Vampire night-fighters gave some cause for anxiety in August 1960 when minute cracks were discovered in the fuselage, and the aircraft were temporarily grounded as de Havilland technical representatives were brought in for inspection and repairs. A limited number of aircraft were cleared, but serviceability remained low thereafter.

Squadron Leader B. S. 'Sikky' Sikand took over command of No. 10 Squadron on 17 August 1961 and remained the boss of the Daggers for the next three eventful years. No. 10 went on alert during the Goa police action in December 1961, crews ready to scramble or carrying out pre-dawn and dusk patrols over the capital, while Hunters of No. 20 Squadron undertook CAPs by day. That bit of excitement was soon over and routine set in again.

Vampires show their age

Fuel pipe burner problems plagued serviceability of the Vampire NF.Mk 54s and this led, in late 1962, to No. 37 Squadron handing back its few serviceable aircraft to augment No. 10 Squadron's inventory, the younger squadron then being equipped with the Hunter F.Mk 56. From the fourth week of October 1962, the squadron was put on immediate alert as the frontier skirmishes with China heated up, but morale was high and the 'Daggers' were ready to defend the country's skies even with their limited resources. However, the frontier war of October-November 1962 did not involve the IAF's combat arm and, when China declared a unilateral ceasefire, the immediate crisis passed, if not the trauma.

With the reduced pressure in 1963 came rumours that No. 10 would convert to the Gnat light fighter but, instead, the unit continued with its faithful Vampire night-fighter, participating in the joint air exercise Shiksha, alongside RAF, USAF and RAAF aircraft in November 1963. The highlight of 1964 was the squadron's 20th anniversary celebrations on 14 February, culminating in the 'night of light with the Black Knights'.

In mid-April 1964, the decision was taken by Air HQ that, pending re-equipment with a new aircraft type, and as the venerable night-fighters were finally to be grounded, No. 10 would be number-plated. And so it was, for three years from April 1964 to April 1967, when No. 10 Squadron was resuscitated at Jamnagar with the Marut, India's first indigenously designed jet fighter.

No. 10 Squadron was reformed on 1 April 1967 on the HAL HF-24 Marut Mk 1, at Jamnagar on the Gulf of Kutch, with Wing Commander C. K. Murthy as CO and Squadron Leaders Ranjit Dhawan and Mickey Jatar as flight commanders. The Maruts were ferried as they became available at Bangalore and test pilots from the Aircraft and Armament Testing Unit oversaw the conversion of pilots to the unique new fighter type. No. 10 Squadron's situation evoked mixed feelings of curiosity, enthusiasm and apprehension in the Air Force.

The Marut years

Wing Commander 'Gaboo' Sen took over on 21 September 1967. Serviceability and non-availability of spares remained major concerns, and the situation became chronic for the rest of that year before it began to improve in 1968. No. 10 Squadron put up a four-Marut box formation over Rajpath in New Delhi on Republic Day (26 January 1968), which was much applauded. The 'Daggers' bore the teething troubles and unserviceability with fortitude, and slowly turned the corner, increasing flying time by September and even carrying out low-level tactical training sorties well out to sea beyond the Rann of Kutch.

No. 10 Squadron was moved to Poona in May 1969 but some of its personnel were posted to the second Marut unit, No. 220 Squadron, with whom they shared this major air base, alongside Canberras and Super Constellations. A considerable number of new pilots were posted in, including Brian de Magry, 'Brother' Bhargava and Pete Gaynor. 'Piloo' Kacker became CO on 11 May 1970, a former fight commander of the squadron, but he was tragically killed in a Marut accident on 1 September at the forward air base of Uttarlai in the Rajasthan desert. His place was taken by Wing Commander K. C. 'Aggy' Agarwal. In November 1970, the squadron won the shallow glide bombing and air-to-ground rocketery trophies during the Inter Command Gunnery meet. The HF-24 Marut was highly acclaimed as an excellent and steady weapons platform, its only handicap in turning combat being lack of engine thrust. A flight participated in the Republic Day flypast in January 1971, the first month of what was to be a significant year for No. 10 Squadron, the Indian Air Force, the

One of No. 10's Marut's is seen being refuelled at Jodhpur Air Base sometime in 1970. Drop tanks were often a necessity for operational Maruts.

nation and the South Asian sub-continent.

Brian de Magary, who flew HF-24 Maruts with No. 10 Squadron, related his experiences with the type, in war and peace.

"My initial association with No. 10 Squadron (the 'Daggers'), though indirect, goes back to April 1967 at Jamnagar where I was posted and where No. 10 was being reformed. The squadron was number-plated after the Vampire night-fighters had been phased out, and was commanded by 'Locky' Loughran. There was considerable string pulling by some 'big guns' to recommend a CO for this 'prize' squadron which was going to be the first to be equipped with the Dr Kurt Tank-designed, HAL-built HF-24 Marut twin-engined fighter-bomber. The selected officer was a complete dark horse, my ex-Officer Commanding from 101 FR Squadron ('Vampires'), V. Krishnamurthy. This Harvard kingpin was a great salesman who brilliantly sold just himself and was known to everyone as 'Murph', but fortunately had 'Jit' Dhawan and Mickey Jatar as his flight commanders, both seasoned fighter pilots. Also in the squadron were C. K. K. ('Mini') Menon, Sisodia ('Sis'), Kapoor ('Jug Jug'), 'Bobby' Kaskear and 'Punily' Sidhu. The Aircraft and Armament Testing Unit (A&ATU), later renamed Aircraft & Systems Testing Establishment (ASTE), at Bangalore moved a detachment with Karan Yadav (OC), some test pilots and engineers including Shashi Ramdas (later Air Marshal) to Jamnagar to convert to the new Maruts. Jackie Pawar was the station commander. However, the Maruts did not do much flying.

"Predictions that 'Murph' would not last long turned out to be correct. Within three or four months, 'Murph' was on a simulated strike mission with a single aircraft. The target was a bridge some 100 miles southeast of Jamnagar. 'Murph' could not locate the bridge, on the way home got lost and could not locate his home base, ran out of fuel and ejected just a few miles away from Jamnagar. In the event, he lost command of the squadron, which was taken over by 'Gaboo' Sen.

Sqn Ldr 'Piloo' Kacker

"In March 1968, I got posted from Jamnagar to No. 1 Squadron at Ambala, then flying Mystère IVAs, and I lost contact with No. 10. Sometime early in 1969, No. 10 moved to Poona, while No. 220 at Poona, then on Vampires with Squadron Leader O. N. ('Piloo') Kacker commanding, was to be re-equipped with the Maruts. 'Jit' Dhawan got his rank and took over No. 220. 'Piloo' was posted to No. 10 and, since he was senior to Mickey, became the senior flight commander. 'Mini' Menon was posted from No. 10 to No. 220 as flight commander around the same time, and AV Kamat was posted from No. 220 to No. 10.

"Around mid-1969, No. 32 Squadron was to be re-equipped with Sukhoi Su-7s and a few of us were posted to No. 10 Squadron. Since 'Piloo' has been a legend, some tales regarding him must be told. He seemed to have taken an instant dislike to me. When we reported to him at No. 10, he singled me out and asked me why I was wearing an 'efficiency badge' on my uniform pocket (it was extremely rare to see a mere flight lieutenant with one). I certainly was the most junior pilot wearing one, but I had a master green rating on Mystères and Vampires.

Later production Maruts, like these, boasted much improved manoeuvrability thanks to a redesigned wing of greater chord. However, this and other modifications increased the aircraft's all-up weight, reducing top speed.

'You think you are hot? Well, we will see!'

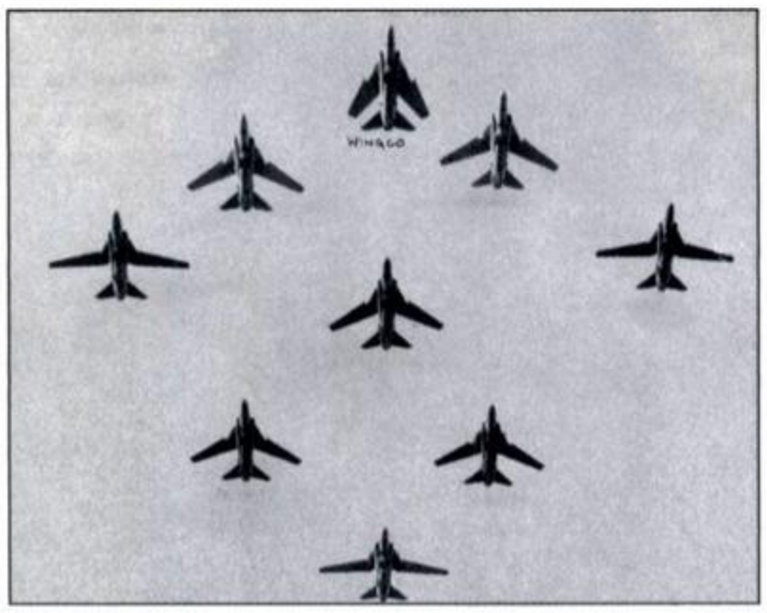
"One day, 'Piloo' took up Agnihotri for a tactical formation sortie. 'Agni' was not a very confident flier and, like most others, was terrified of 'Piloo'. As expected, 'Agni' did not perform to 'Piloo's' standards. After the sortie the CO called all of us 'youngsters' to attend the debrief. He started, 'We were supposed to do a

After finally relinquishing their Maruts in 1980, the 'Winged Daggers' re-equipped with their first Soviet aircraft – MiG-23BNs. Here, F/O P. V. S. Shekhar poses with his newly-repainted aircraft (and some of its stores) in 1992.

The Commander, Pacific Air Forces, USAF, General John G. Lorber, visited No. 10 Squadron at Jodhpur in 1996 and is seen here with Air Marshal Deshpande, AOC-in-C South Western Air Command, after a flight in an IAF MiG-23U.

formation sortie. That was not formation flying. There happened to be two aircraft flying in the same sky, in the same general direction.' After chewing up 'Agni' until he was on the verge of tears, 'Piloo' then proceeded to tell us a joke. 'Piloo' had a terrific sense of humour and an inexhaustible stock of dirty jokes.

"'Piloo' took me up for a tactical formation flying sortie, although at that time I had fewer than 15 hours on Maruts. After some very rough manoeuvres at height, 'Piloo' called up to say that the pitot head had broken off and that he had lost all his pressure instruments, namely the ASI, VSI, altimeter. He asked me to join up in close formation and shepherd him in for landing. 'Gaboo' and Mickey rushed to the control tower to watch and, if necessary, to give advice. We joined circuit, turned downwind, lowered undercarriage, flaps, etc. and came in on finals. I was very steady on the right-in-close formation, as I had plenty of experience in this sort of thing with 'Toofanis' and Mystères, since, as those aircraft had no trainers, pilots were shepherded by flight commanders on first solos. My one concern was at what height I should go around. I decided to go around low, and when 'Piloo' touched down and I was a few feet off the deck, I opened up, turned down wind and subsequently landed. Back at the tarmac I was informed that 'Piloo' wanted me in his office. I was shocked when he chewed me out for going around 'high', for abandoning the leader, when he had a serious emergency! Later I was summoned to 'Gaboo's' office, where, not at all to my surprise, I got chewed up by him for coming so 'low' when I had such little experience on type. 'Gaboo', of course, was surprised when I then informed him that I had just been chewed out by 'Piloo' for going around 'high'!



Led by No. 10's CO, Wg Cdr R. L. Bamzai, nine of the unit's MiG-23s illustrate the type's variable geometry during a display.

Attack on Poona

"On another occasion, 'Piloo' ordered a four-aircraft strike mission to carry out simulated gun attacks on Poona airfield, with two aircraft to provide CAP. 'Gaboo' was to lead the strike, Mickey was No. 3, I am not sure who Nos 2 and 4 were, possible Sis and Bobby, and 'Piloo' was to lead the pair to provide CAP. There was excitement in the air as we searched the sky for the strike formation. We watched the CAP aircraft. Suddenly we heard the roaring sounds of 'Gaboo's' formation zooming in at very high speed. We saw 'Piloo' and his No. 2 dive and latch on to one pair (Mickey and his No. 2) and after some time the attackers retreated and the CAP aircraft disengaged. It looked great. The Marut could really clock knots if you gave it the gun. Achieving 600 kt was no big deal and the aircraft handled beautifully.

"For the debrief, 'Piloo' ordered all of us into the briefing room. After 'Gaboo' finished his debrief, which was really just a formality, 'Piloo' took over. He chewed out 'Gaboo' (his own OC) and Mickey and kept blasting them about how strikes should not be done, and if they had come down to anything more than 50 ft, then he was a 'monkey's uncle'. Never a dull moment!

"By May 1970, 'Piloo' got his rank and took over command of No. 10 Squadron. 'Gaboo' and Mickey were posted to Air HQ. Some of us acquired 'ops' status on Maruts later, and it was probably in September 1970 that detachments from Nos 10 and 220 Squadron went to Uttarlai for operational flying. 'Jit' Dhawan led the detachment from 220 and 'Piloo' from 10. My posting to 220 as flight commander was already out and I was tremendously relieved that I would soon be 'safe' from Piloo.

"After 'Piloo', Pete Gaynor officiated as OC No. 10 Squadron and then handed over to K. C. ('Aggy') Agarwal, the squadron moving to Poona, along with the other formation with Maruts, No. 220 Squadron. It was also around this period that around six young pilot officers, including V. J. Singh Khokhar and Kochar, were posted from the OTU direct to No. 10 Squadron, but 'Gaboo' refused to allow them to fly due to the numerous problems on the aircraft. Both squadrons were doing a fair amount of flying but the Maruts were beginning to gain notoriety because of their many problems and defects. Modifications were in the hundreds. It was only because of the very meticulous and systematic reporting of incidents, and professionalism of pilots and engineers, that there were no fatal accidents.

"I remember, for instance, when I was with No. 10 Squadron, we discovered that gun vibrations were so excessive, and gun-sight mountings used to become so loose, that after one or two sorties the gunsight could be rotated easily through 10° or 15° either way. It thus became necessary to harmonise the aircraft after every one or two gun-firing sorties, a very tedious and time-consuming procedure. It was also known that 'Chu Chu' Tilak (later chief test pilot at HAL, Bangalore) had twice lost his canopy during four-gun firing trials, since the canopy external jettison switch, which was located in the nose, used to get activated electrically. We often joked, 'Thank God the ejection seat is not electrically activated!'

Excellent weapons platform

"However, we eventually learned to love the Marut, which was an excellent and steady weapons platform. Both squadrons moved detachments to Chandigarh in November 1970 for the Inter Command Weapons Meet. The best pilots in the IAF would compete for honours. It was a matter of pride that Chauhan from No. 10 and I from No. 220 topped in rocket and gun firing, respectively. We had also acquired a reputation for scoring full marks for ETA or TOT in every competition or flypast because our time was always less than 10 seconds. There was one very embarrassing exception when, for the final Republic Day flypast, our formation (220 led by 'Jit' Dhawan) flew parallel to Rajpath but just behind the President, owing to a last-minute correction in order to lose a few seconds."

Civil strife and war-like events in then-East Pakistan had exacerbated tensions between India and Pakistan from early 1971 and contingency plans were worked out in detail for any eventuality. No. 10 Squadron moved a detachment from Jodhpur to Uttarlai, its forward base for operations, as part of Operation Cactus Lily.

The 'Daggers' shared Uttarlai base with a detachment of MiG-21FLs from No. 29 Squadron ('Scorpions'), its essential role being

This trio of rocket pod-toting No. 10 Squadron MiG-23BNs illustrates the two camouflage schemes applied to the aircraft. The yellow disc on the nearest machine will probably form the background for a 'winged dagger' badge.

close air support for the Army, tactical reconnaissance, interdiction and counter air missions. Following Pakistan's 'attempted' pre-emptive strike on the evening of 3 December 1971, the base went on full alert; it received its first B-57 bomber raid at 20.00. On the morning of 4 December, No. 10 Squadron flew its first offensive mission of the war, mission X-01 having four Maruts heading low level for a counter-air strike on Hyderabad-Sind airfield. No aircraft were seen but airfield installations were hit, and all aircraft returned safely to base. Next mission was a Tac/R sortie, in which strikes against targets at Chor and another counter-air strike against Hyderabad-Sind were flown, and a POL dump destroyed. Two Maruts carried out steep glide-bombing attacks with 1,000-lb (454-kg) bombs against targets in Naya Chor, from which considerable damage resulted. The next day had the Maruts rocketing trains at Dhoro Naro, in addition to other Tac/R missions against targets of opportunity.

Tac/R missions were flown the next day along Naya Chor, Dhoro Naro, Sufi Fakir and Umerkot. There were few targets on the ground but the Maruts spotted and turned towards eight Pakistani Sabres strafing Indian positions, but promptly disengaged.

Train-busting

On 9 December, No. 10 Squadron carried out rocket and gun attacks against Mirpur Khas railway yards, making repeated firing passes against wagons and locomotives. Yet another strike against Hyderabad-Sind airfield was mounted, and this is when No. 10 lost its first aircraft to enemy air defence guns. The same evening, two Maruts returning from a mission were bounced by PAF Sabres but outflew the chasing fighters with their superior performance at deck level.

On 10 December, the Maruts of No. 10 Squadron again struck against troop and ammunition trains at Mirpur Khas railway yards, making repeated attacks that resulted in spectacular explosions and the destruction of 80 to 100 wagons. More sorties were flown against enemy entrenchments in the Naya Chor areas, these being hammered with 1,000-lb bombs and 68-mm rockets.

On 11 December, two PAF F-104 Starfighters carried out a low-level counter-attack against Uttarlai airfield and caught two HF-24s taxiing out for a sortie. Both Maruts were struck by rapid cannon fire and were destroyed but, miraculously, both pilots extricated themselves from the blazing aircraft. Notwithstanding this loss, another pair of Maruts was airborne soon after and attacking enemy defence positions around Naya Chor, the ordnance during the next two days including rockets and napalm. Tac/Rs continued to be flown along the Umarkot-Dhoro Naro-Naya Chor axis; trucks and APCs were engaged with front guns, and targets of opportunity in this vast desert area included stray army convoys and odd gun positions.

This is a typical scene at the Daily Servicing Section at No. 10 Squadron's Jodhpur base in the 1990s. The sign on the right-hand wall reads, "Devotion to duty is not a sacrifice – it is a justification of your existence in this world".

On 17 December, the last day of the war, two Maruts of No. 10 Squadron were detailed to attack enemy positions at Umarkot, escorted by two MiG-21FLs as top cover. The Maruts

SM294, one of No. 10's first MiG-23BNs, poses with a load of French BAP 100 airfield attack bombs under its wings.

Above: No. 10's new MiG-23BNs are seen here on the ramp at Jodhpur, shortly after delivery. Aircrew were sent to the USSR for conversion training before the aircraft were delivered in 1981. The so-called 'swinger' era at No. 10 Squadron is expected to continue well into the 21st century.

were bounced by two F-104s which in turn were chased by the MiG-21s, both Starfighters being quickly shot down in flames. Umarkot was struck by other Maruts in a second sortie, the last action of the war before a ceasefire was announced that evening. No. 10 Squadron had put up a great show, the Maruts had been blooded in battle, and for their excellent performance the 'Daggers' were awarded two Vr.Cs, one VM and two mentions-in-dispatches.

Brian de Magary, again, recalls the 1971 war service: "The two squadrons had moved to Jodhpur in December 1970. I was with 220 until July 1971 when I was posted to 32 Wing as the SFSO, but I flew regularly with both squadrons. In November 1971 I was attached to No. 220 Sqn and both squadrons moved detachments to Uttarlai in anticipation of a possible war. Mickey was attached to No. 10 Squadron. Both squadrons performed creditably during the war but not without loss.

Starfighter attack

"Mickey and 'Punchy' were lined up for take-off on a strike mission when the airfield was attacked by two F-104 Starfighters. I was in a blast pen, waiting for my aircraft to be readied, when the incident took place. The siren went off, I heard these unfamiliar jets roar in, followed by the very rapid fire of Gatling guns, and then the 'phut phut phut' of anti-aircraft guns. I peeped out to see a Marut on the runway going up in flames and Mickey jumping from the cockpit, his left sleeve burning. He rolled on the ground to put out the fire. 'Punchy' got out by sliding rearwards down the fuselage, onto the wing, and then let himself on to the ground before running for cover. The F-104s came in for a second pass. 'Punchy's' aircraft was hit, but got away with a few holes in the fin and rudder.

"Kamy got shot down during an attack on Hyderabad (Sind) airfield and was taken POW after ejecting. 'Dinky' Jatar (probably in No. 10) lost one engine on a mission well inside enemy territory, but got back safely 'on one'.

"After the war, we moved back to Jodhpur and I was posted to No. 10 Squadron in place of Kamy. Pete and I were flight commanders under 'Aggy', and did a tremendous amount of flying on Maruts. With AVM Subia as our AOC-in-C, we were able to get spares much quicker than earlier. Around May 1972 we received a Hunter and I managed to acquire captaincy on the trainer through a lot of perseverance and effort, since I did not have more than 15 hours on Hunters. I was later to be appointed command examiner for both Maruts and Hunters, but unfortunately was declared unfit for fighter flying because of weak eyesight! Thanks to the C-in-C, I converted to Mi-4 helicopters and subsequently went on to Dakotas.

"I should have mentioned that HAL had by now started manufacturing a new series of the HF-24 Marut. The aircraft had very poor capability in turns because of its very thin wings and terribly underpowered engines, so the length of the chord was increased to give greater wing area and therefore more lift. It had several other improvements, like a more sophisticated ISIS gunsight and several cockpit changes and modifications. Since the weight of the aircraft increased, its top speed was less than that of the earlier series.

"The new series started arriving at the squadrons in January 1971, starting from s/n 1192 onwards and, at its peak, No. 10 Squadron had on charge 32 Maruts and three Hunter trainers, but probably did not hold more than the unit-establishment of 16 Maruts and two Hunter trainers at any one time.

"Squadron Leader K. K. Bakshi ('Joe') joined No. 220 when the squadron moved from Poona to Jodhpur. He and I were 'Jit's flight commanders in 220 in Jodhpur and 'Minnie' had been posted to the ASTE. Around late 1973 or early 1974, 'Joe' took over No. 10 from 'Aggy'. Pete Gaynor had to undergo major surgery around the same time and was posted out. Around this time I was also posted out – my last Marut and Hunter trainer sorties were on 13 November 1973. I remained in 32 Wing, converted to the Mi-4 and left Jodhpur mid-1974 for Dakota conversion.

"Thus ended a very exciting phase in my Air Force flying career, the 'high' being my five years flying the HF-24 Marut for nearly 500 hours, a beauty of an aircraft which I shall never forget."

Nos 10 and 220 Squadrons, both flying Maruts, were based together at Jodhpur after the December 1971 operations, an association and location that was destined to continue through the next two decades and beyond, albeit with new types of aircraft. Serviceability was high, flying rates were excellent, the 'Daggers' were completing their tasks with aplomb, an average of 240 hours being flown every month. During one army co-operation exercise out of Jaisalmer, the squadron flew so much that the Army ran out of targets and the station out of fuel!

Popular Maruts

The HF-24 Marut remained No. 10 Squadron's mount until the end of the 1970s. This first Indian-designed and -built combat aircraft had a steady, if not spectacular, career and was much liked by its pilots for its aerodynamic and handling qualities. The 'Daggers' had honed the Marut into a fine weapon system, taking part in various air exercises and gunnery meets, winning trophies for the 'Best Marut Squadron' in 1977 and being declared 'Squadron of the Year' in 1978 in the transonic fighter group for maximum flying with a zero accident record. The first two-seat Marut operational trainers were received in January 1975, supplanting the faithful Hunter trainer. A third Marut squadron, No. 31, had been formed in early 1974. In May 1975, No. 10 Squadron took on the additional responsibility of becoming a type-training squadron for the HF-24, continuing this dual role until 1 August 1980, when its Maruts were allocated to the other

squadrons in preparation for No. 10's conversion to a new, third-generation tactical strike aircraft, the variable-sweep MiG-23BN fighter from the Soviet Union.

Earlier, Wing Commander K. K. Bakshi had taken the reins of the 'Daggers' on 1 February 1974, in turn being succeeded by Wing Commander C. K. K. Menon on 8 January 1977 and then Wing Commander D. S. ('Dinky') Jatar on 11 December 1979. The squadron line-up in 1976 had Wing Commander K. K. Bakshi as CO, Squadron Leaders Iqbal Singh Bindra (who had shot down a F-104 in 1971 while flying MiG-21s) and C. S. Dhillon as flight commanders, and a total of 27 officers on strength including the 'spanners'.

MiG-23 conversion

The 'Daggers' bade farewell to Maruts in August 1980 and remained in suspended animation for the next four months, even as eight pilots, nine engineering officers and 55 airmen left for the Soviet Union for conversion training on the MiG-23 swing-wing fighters and its advanced nav-attack systems. Arriving at Moscow on 1 September 1980, the teams flew on to Frunze and then by train to Lugovaya in the Kazakhstan Republic to begin training, which was completed by the end of December. No. 10 Squadron was reformed on 1 January 1981 at Jodhpur, commanded by Wing Commander R. L. Bamzai, and the first MiG-23BN aircraft was handed over at Ozar (Nasik) on 20 January. True to tradition, the top brass wanted the IAF's latest acquisition to be publicly displayed on Republic Day (only six days later), so the first of the 'swingers' was flown over the capital as required. The first MiG-23BN was flown to Jodhpur on 11 March, ceremoniously escorted in by four Maruts. By August, enough MiG-23BNs, and the trainer variants, were available for the 'Daggers' to start converting their old comrades-in-flight, the 'Desert Tigers' (No. 220 Squadron), to the swing-wing fighters.

HAL-built MiG-27MLs replaced No. 10's MiG-23s from late 1993. The IAF ordered a total of 165 'Flogger-Js' and is considering an avionics upgrade for the turn of the century.

January 1982 (the year of the IAF's Golden Jubilee) saw the 'swinger' force take part in the Republic Day flypast in a big way: MiG-23BNs and the MiG-23Us were temporarily based at Ambala to operate alongside IAF Jaguars, a most unusual line-up! The MiG-23BNs subsequently took part in the Fire Power Display at Tilpat and were then inspected by the visiting Soviet Defence Minister Marshal Ustinov and his delegation, who were most impressed by the professional displays put up. The first 'Dagger' chief of the MiG-23 era, Wing Commander R. C. Bamzai, was posted out at the end of April 1983, handing over to Wing Commander K. B. Menon.

No. 10 Squadron was presented with its colours by the President of India, Gyani Zail Singh, in a splendid ceremony at Jodhpur on 18 March 1985. The MiG-23BNs lined up alongside HS.748s of No. 11 Squadron, which was also receiving its colours.

The 'Daggers', the 'swinger' pioneers in the Indian Air Force, continued to operate the MiG-23BN from Jodhpur, participating in various exercises and armament meets over the rest of the decade. Wing Commander V. K. ('Jimmy') Bhatia (later an Air Marshal) assumed command on 27 May 1985, in turn being followed by Wing Commanders J. S. Thakur on 24 November 1986, V. K. Verma on 28 November 1988, R. Jaisinghani on 26 November 1990 and G. S. Kocher on 13 November 1992.

The 'Daggers' put up a nine-aircraft diamond formation flypast in November 1987 ('Daggers Diamond') for which the MiG-23BNs displayed different wing-sweep positions. No. 10 Squadron later gave a display of toss-bombing techniques at the Pokhran ranges during Exercise Hammerblow in March 1988, receiving a special commendation from the AOC-in-C, South Western Air Command. In September that year, 'Dagger' MiG-23BNs took part in an unusual formation of all MiG types in service with the IAF at Poona, including the newly inducted MiG-29s.

MiG-27s from HAL

After almost exactly 12 years on the MiG-23BN, No. 10 Squadron re-equipped with the HAL-built MiG-27ML, a variable-sweep strike fighter. The MCF for the aircrew, technical officers and ground crew was conducted at No. 1 TETTRA from 1 November 1993. Led by the CO, Wing Commander G. S. Kocher, the first four MiG-27MLs were ferried from HAL Ozar (near Nasik) on 14 December 1993, the balance of aircraft arriving by the end of the month. Operational flying commenced thereafter and by the end of February 1994, the 50th anniversary of its establishment, No. 10 Squadron was fully operational on the MiG-27ML, the eighth aircraft type in an inventory stretching over half a century.

The 'Winged Daggers' continue in fine form with the MiG-27ML, spearheading the IAF's tactical strike force into the new millennium.

Pushpindar Singh

Ground crew swarm around MiG-27 TS618 prior to a training sortie from Jodhpur.

Fairey Firefly Variants

When the Fairey Firefly entered squadron service in late 1943, the Fleet Air Arm at last had a robust two-seat fighter, not only well armed with four 20-mm cannon but capable of delivering an array of air-to-ground ordnance. It quickly proved popular with crews. While it lacked the speed of a single-seat fighter, it had a high cruising speed, good deck landing characteristics and, in the hands of an experienced pilot, could more than hold its own against its single-seat counterparts.

Perhaps the most eye-catching Fireflies were the FAA's T.Mk 1s, finished in all-over trainer yellow to aid conspicuity in the deck-landing conversio role. Here an example (Z2027, notably with the original shallow front cockpit screen) formates with another destined for the Royal Netherlands Naval Air Service in early 1948. Four F.Mk Is were converted by Fairey for the RNNAS; three T.Mk 2s delivered between 1949 and 1952 were converted locally. The type survived in Dutch service until 1960.

Although the Fairey Firefly never came up against the formidable German duo of Bf 109 and Fw 190, it took on and shot down Japanese fighters, such as the Nakajima Ki-43 Hayabusa, encountered when operating with the British Pacific Fleet (BPF).

Such was its usefulness that some 1,702 were built in no fewer than five major versions and a number of sub-variants; it was operated by at least eight other countries, operationally with some of them. The change in design to the Mk 4 only reinforced confidence in the basic layout, as the Mk 5 was operated with great success in all weathers off British and Australian carriers during the three-year Korean War. Its final role was that of target drone, both with the Guided Weapons Development Squadron (GWDS) at Llanbedr, and No. 728B Squadron on Malta. There are only three Fireflies flying in 1998, but recent news of others being recovered from Ethiopia for rebuild to flying condition, plus a hybrid in the US, could double those numbers by 1999 – the 60th anniversary of its inception.

A change in policy

At a Tender Design Conference on 5 January 1940, when the single-seat and two-seat naval fighter projects originating from the Air Ministry Specifications N.8/39 and N.9/39 evolved into N.5/40F, a dramatic change in Admiralty policy towards naval aircraft had taken place. After only a short spell at war, the Royal Navy had recognised that the performance of fighters operating from carriers would only be enhanced if the amount of equipment carried by these aircraft was drastically reduced. Performance would be paramount in the new range of aircraft being ordered and destined for introduction with front-line units within two years. The aircraft then in service were for the most part unsuitable and/or obsolete, often adaptations of RAF aircraft. British naval aircraft in 1940 left much to be desired.

The original specifications of 1939 had called for a two-seat 'front gun' fighter (i.e., with forward-firing guns) and for one with a turret, like the Blackburn Roc and Boulton-Paul Defiant, respectively. The latter was a non-starter, considering its weight and recent RAF combat experience of the Defiant. The former (N.8/39) eventually became the Firefly, while N.9/39 was revised to become a single-seat version of the two-seater, with the turret deleted.

Fairey submitted a design that could be adapted to fill both specifications, which were then combined as the two-seat N.5/40F, written around what was to become the Firefly.

Firefly prototype Z1826 is seen at Great West Aerodrome (now part of London's Heathrow Airport) around the time of its first flight there on 22 December 1941. Its only marking was a serial number on the rear fuselage.

This classic Charles E. Brown portrait shows one of the first production Firefly Mk Is. Generally, Fireflies of Mks I, II and III are referred to using Roman numerals, while subsequent marks are given Arabic mark numbers. From 1947, Arabic numerals were used for all variants, including Mks I, II and III aircraft that remained in service.

It order to get the new aircraft into service within two years, it was recognised that the usual process of testing prototypes and development aircraft would have to be revised. After various submissions, the new Rolls-Royce Griffon engine was selected to power the new fighter. The Griffon had been given the go-ahead in December 1939 and was designed from the beginning to provide high power at low altitude – ideal for a naval fighter. Initially, it gave 1,735 bhp (1295 kW) at sea level but later versions were capable of over 2,100 bhp (1567 kW).

Initial Firefly production centred around 200 aircraft – two prototypes, 11 development machines and 187 production aircraft, though in the event, the two prototypes became four and at least 15 other Fireflies were used to speed development.

The first works drawings to enable production to begin at Fairey's Hayes, Middlesex factory were issued to shop floor staff in March 1941. The Ministry of Aircraft Production (MAP) followed the first order for 200 with an additional 100, and then in May 1942 added a further 300. The MAP was looking for 50 Fireflies per month until, at least, the end of 1944. There were many changes to the numbers of different marks ordered as the war progressed; for instance, on 28 April Fairey was informed by the MAP that the programme was 300 Mk Is, 100 NF.Mk IIs and 200 Mk IIIs. By August this had been changed to 500 Mk Is, 200 NF.Mk IIs and 100 Mk IIIs, and by October it was 350 Mk Is, 350 NF.Mk IIs and 100 Mk IIIs.

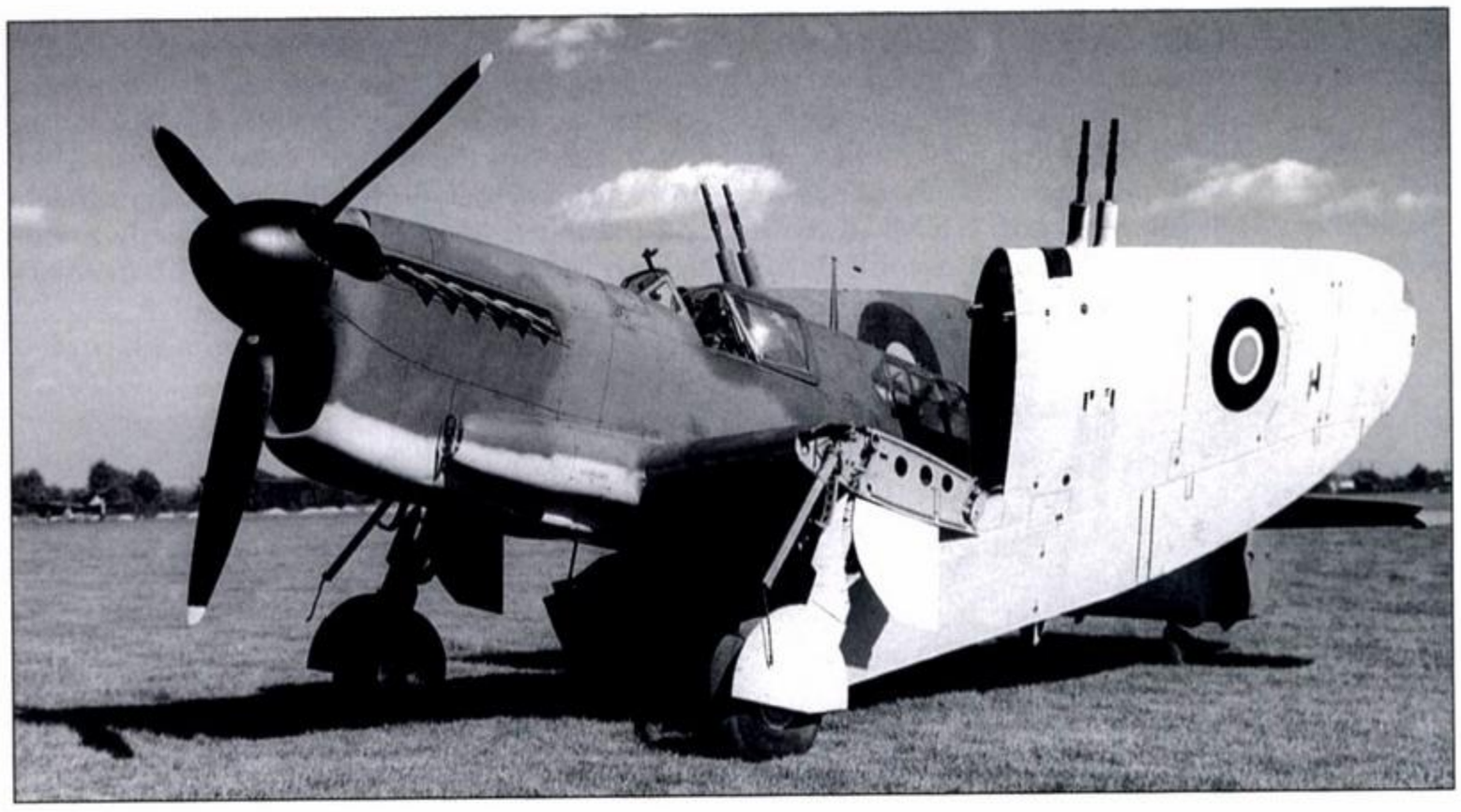
Design features

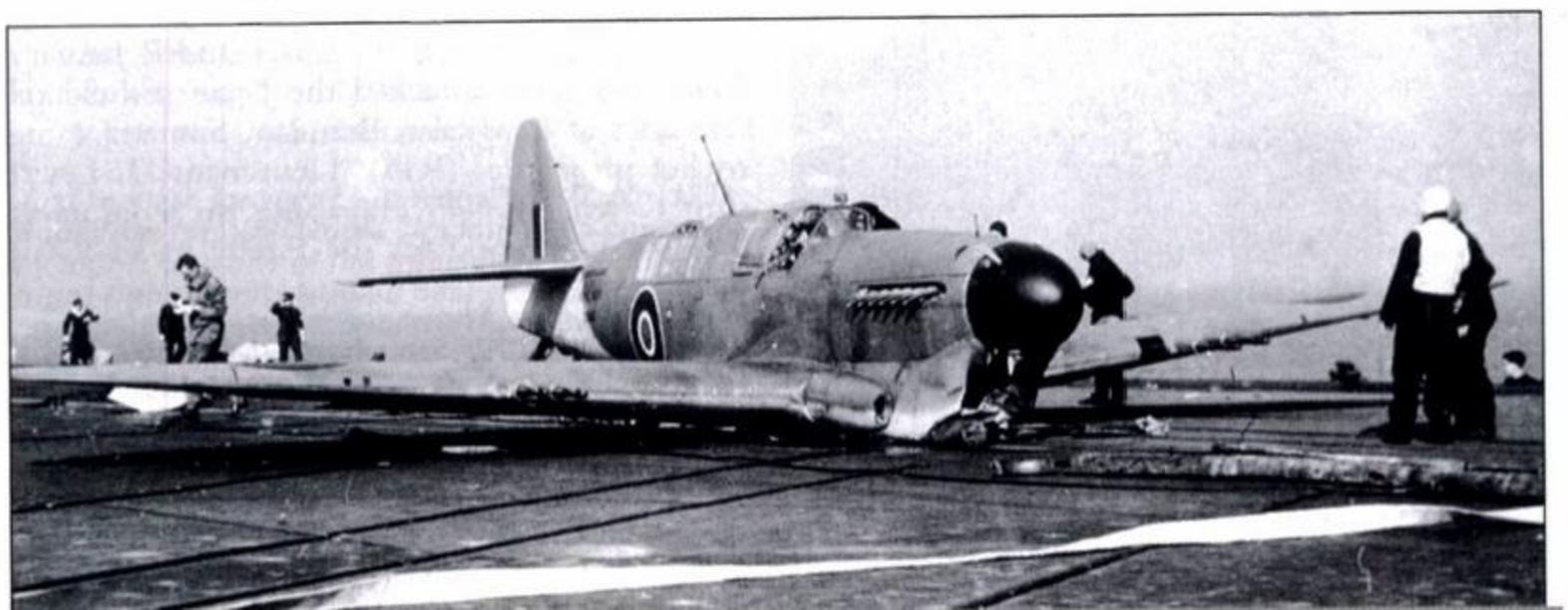
The initial production Firefly had a low raked windscreen with a wind-driven wiper and a low, flat pilot's canopy faired in with the fuselage lines. The wiper, reflector gunsight and heavy metal framework combined to give the pilot a poor view forward. An early design change removed the wiper, thinned the framing and raised the windscreen, the latter necessitating a raised canopy which not only gave a better view but more headroom.

Although the Firefly was similar in outline to its predecessor, the Fairey Fulmar, there were significant differences. The Firefly had a semi-monocoque fuselage of oval section, built using Fairey's unique jigging system whereby the fuselage was built in two halves, doing away with longitudinal stringers and instead utilising U-frames to support a smooth metal skin. The wings, folded manually, were turned upward from a pivot on the rear spar and then rearwards to lie alongside the fuselage.

One of the most outstanding features of the Firefly was its Youngman flaps. The Fairey-patented Youngman area-increasing flaps were fully retracted for high-speed flight, but were extended on tracks to increase wing area for

With its wings neatly folded, the Firefly was a comparatively compact machine. It was not until the advent of the Mk 5 that hydraulic wing folding was introduced on the Firefly. By the time the 'universal' Mk 4/5/6 variants appeared, the intakes under and on either side of the nose had been relocated to the inner wing leading edge, the wings had been 'clipped' and a more powerful Griffon engine installed, driving a four-bladed propeller.





Left: Test pilot Captain Eric Brown came to grief on 9 September 1943 aboard trials carrier HMS Pretoria Castle. Firefly Mk I Z1844 was engaged in trials aimed at gauging the type's compatibility with a smaller carrier than the Illustrious, on which the type was initially and successfully tested. In this instance Z1844's tail hook failed to lower (despite a glowing indicator light on his instrument panel that suggested it had!), the aircraft careering into the crash barrier, losing its undercarriage and sliding along the deck on its belly "in a shower of wood splinters from the shattering propeller."

Z1832 was the seventh Firefly built and was sent to A&AEE Boscombe Down in 1943 for trials with a strengthened aileron, aimed at curing 'lightness' in the aircraft's controls. Metal-skinned elevator trials followed. It went on to serve with Nos 1770 and 768 Squadrons. By June 1943, 22 Mk Is were engaged in various test activities, principally at Boscombe Down, RAE Farnborough and Rolls-Royce, Hucknall. On 7 July, the type was released to the Service, the first operational aircraft going to No. 1770 Squadron the following October.

Left: Z1945/'C' of No. 1772 Squadron, then based at Burscough, cruises over Lancashire sometime before October 1944, when the unit adopted the prefix '4' in its code. In November the unit re-equipped with new aircraft and departed for Australia. Z1945 has the shallow windscreen and canopy and unfaired cannon of early production Mk Is.

cruising, in effect an early form of variable geometry. The outstanding feature of this design was the flaps' ability to be lowered by the pilot to decrease the Firefly's turning circle. This provided the aircraft with excellent manoeuvrability, enabling it to out-turn many contemporary single-seat fighters.

Unsatisfactory Mk IIs

On the production line, the Mk I was joined by the NF.Mk I, FR.Mk I and NF.Mk II, with older Mk Is being upgraded to the FR.Mk I standard as F.Mk IAs with modification kits. The NF.Mk II night-fighter proved something of a failure. Placing extra night-fighter equipment (AI Mk X radar) in two radomes on each wing leading edge led to out-of-range centre of gravity problems. With the additional weight of associated equipment installed in the observer's cockpit, a plan to insert an extra 15-in (38-cm) bay in front of the firewall only aggravated the problem. The Mk II was directionally unstable and the initial MAP plan for 100 Firefly night-fighters looked decidedly shaky. Its unsuitability as a carrier night-fighter was confirmed after trials aboard HMS *Ravager* when the trials aircraft crashed.

The NF.Mk II was abandoned in June 1944 when it was realised that, with relatively small changes, the FR.Mk I could be adapted to provide the FAA with a night-fighter. The Mk II order, by now increased to 328 aircraft, was reduced to the 37 committed on the production line; some of these were later converted to NF.Mk I standard. The key to the change was the availability from the United States of AN/APS-4 (Army-Navy/Airborne Pulsed Search, Type 4) radar, or ASH (Air-to-Surface H) as it became known in the FAA. ASH replaced AI Mk X and its compactness – it weighed only 200 lb (91 kg) – allowed it to be contained in a streamlined transmitter/receiver pod mounted beneath the nose. The changes were quickly introduced on the production line and NF.Mk Is were produced concurrently with the FR.Mk I. The delay to the night-fighter programme had been just six months.

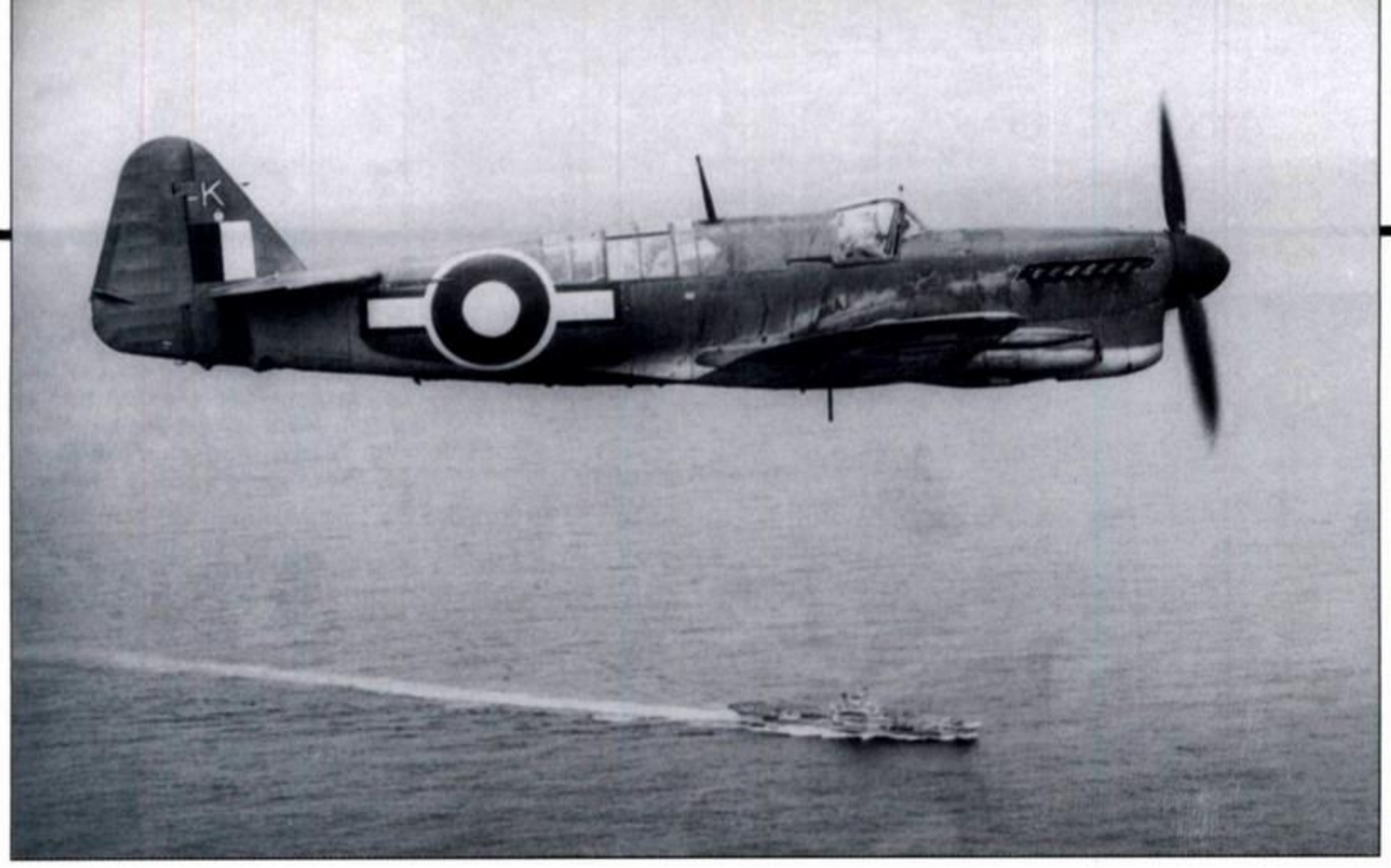
Joining up

Such were the plans for the Firefly that a whole new range of squadron numbers was allocated, the first one, No. 1770, forming up at Yeovilton on 1 October 1943. The second unit, No. 1771, was formed at Yeovilton on 1 February 1944, followed by No. 1772 at Burscough on 1 May 1944. Plans to equip three others – Nos 1773, 1774 and 1775 – were scrapped at the end of hostilities with Japan.

No. 1770 Squadron, embarked in HMS *Indefatigable*, was the first to see action, in strikes against the *Tirpitz*. The unit was given the task of flak suppression, a difficult one in the confines of a fjord, and at least one aircraft was lost to flak.

The squadron then sailed to Ceylon (now Sri Lanka) to join the BPF. On 1 and 7 January 1945, No. 1770 attacked the Japanese-held oil refineries at Pangkalan Brandan, Sumatra using rocket projectiles (RPs). Lieutenant D. Levitt shot down a Ki-43 Hayabusa on 4 January, drawing first blood for the Firefly in air-to-air

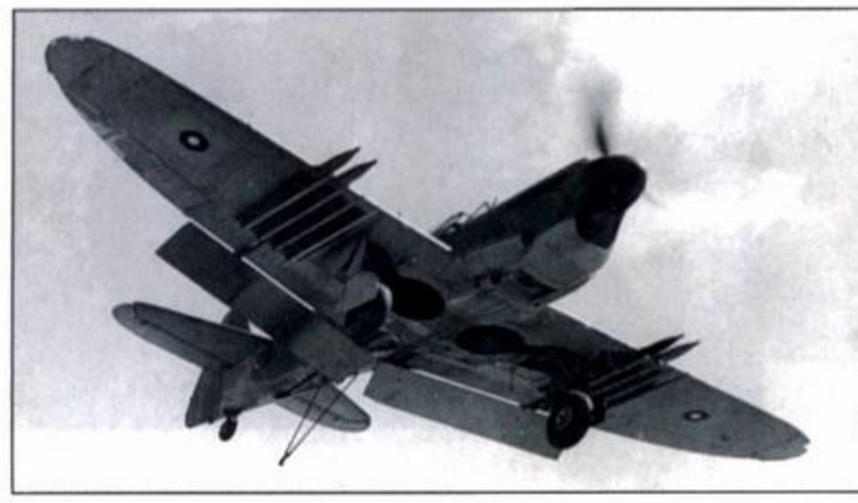
Having returned from a sortie over Sumatra, Fireflies of No. 1770 Squadron aboard HMS* Indefatigable *in early 1945 are prepared for stowage below decks. The aircraft nearest the bow is fitted with rocket rails.



Fairey Firefly Variants

Left: This No. 1772 Squadron Firefly F.Mk I is seen over HMS* Indefatigable*, towards the end of the war. It carries the Extra Dark Sea Grey colour scheme applied at this time, plus the Allied South Pacific roundel with bars.

Below: No. 1770 Squadron, formed at Yeovilton on 10 September 1943, was the first equipped with the Firefly and the first to take the type into action. In July 1944, No. 1770 undertook attacks from HMS* Indefatigable *against gun positions and auxiliary vessels protecting the German battleship* Tirpitz *off the coast of Norway. By the end of the year, No. 1770 Sqn had moved to the Far East to attack the Japanese oil refineries on Sumatra. On 2 January 1945, an aircraft from this unit scored the first air-to-air victory by a Firefly.



combat. Another was shot down and shared by Sub-Lieutenants Stott and Redding. Two more Hayabusas fell to the 20-mm cannon of No. 1770 on 24 January when RP strikes were made against refineries at Palembang. The Fireflies, leading the strike, had to fly through balloon barrages and intense flak. It was to prove an excellent debut for the new fighter and on 29 January three more Hayabusas were shot down by the Fireflies of No. 1770.

Moving up to the Admiralty Isles as part of Task Force 57, the Fireflies were to the fore in strikes on Japanese airfields on Miyako, only 230 miles (370 km) southwest of Okinawa. On one occasion, four of the squadron's Fireflies were escorting a USN Martin Mariner flying-boat to pick up ditched aircrews near the Sakashima Gunto islands. Spotting five Mitsubishi Ki-51 dive-bombers heading for Okinawa, the Fireflies set off in pursuit and shot down four and left the other smoking.

Further strikes were made before the BPF withdrew to Australia to replenish. No. 1770 Squadron was disbanded. In the meantime, No. 1771 in HMS *Implacable* carried out air strikes against targets in the Caroline Islands and became the first FAA aircraft to fly over the Japanese mainland. It was joined in July by No. 1772, which had replaced No. 1770 aboard *Indefatigable*. With the end of the war in sight, No. 1772 was given the task of locating POW camps and dropping Red Cross supplies.

Night-fighter interception unit

With the availability of NF.Mk Is, No. 746 Squadron formed up at Lee-on-Solent on 23 November 1942 as a naval night-fighter interception unit. Initially it operated Fulmars but started to receive Firefly NF.Mk Is in May 1943. This unit provided aircraft and crews to operate from RAF Coltishall in Norfolk, intercepting Heinkel He 111s over the English Channel and North Sea that were releasing V-1 flying bombs against British targets. Although quite a number of these night sorties were flown, no Fireflies ever shot down an He 111.

The first dedicated naval night-fighter squadrons was No. 1790 formed at Burscough on 1 January 1945, followed by Nos 1791 and 1792 at Lee-on-Solent on 15 March and 15 May, respectively. Although No. 1790 joined the BPF, it was too late to be used operationally. No. 1791 was soon disbanded but No. 1792 undertook trial flights investigating whether future night-fighter tactics favoured single-seat or two-seat aircraft. In the event, the Firefly was chosen, but instead of specific squadrons being formed, a flight of four Firefly NF.Mk Is was attached to existing units operating from carriers. Known as 'Black Flights', they moved from squadron to squadron.

By the end of 1946, 872 Fireflies had been built: 327 F.Mk Is, 376 FR./NF.Mk Is and the 37 NF.Mk IIs. General Aircraft Ltd at Hanworth had been sub-contracted by Fairey to build 200 Firefly F.Mk Is but this number was reduced to 132 with the end of the war.

The last operational Firefly FR.Mk Is were those of No. 827 Squadron in HMS *Triumph* during the early months of the Korean War.

Post-war changes

The Firefly was the FAA's standard two-seat fighter-bomber of the immediate post-war years, usually operating with Sea Fury squadrons in air groups aboard the British light carrier fleet.

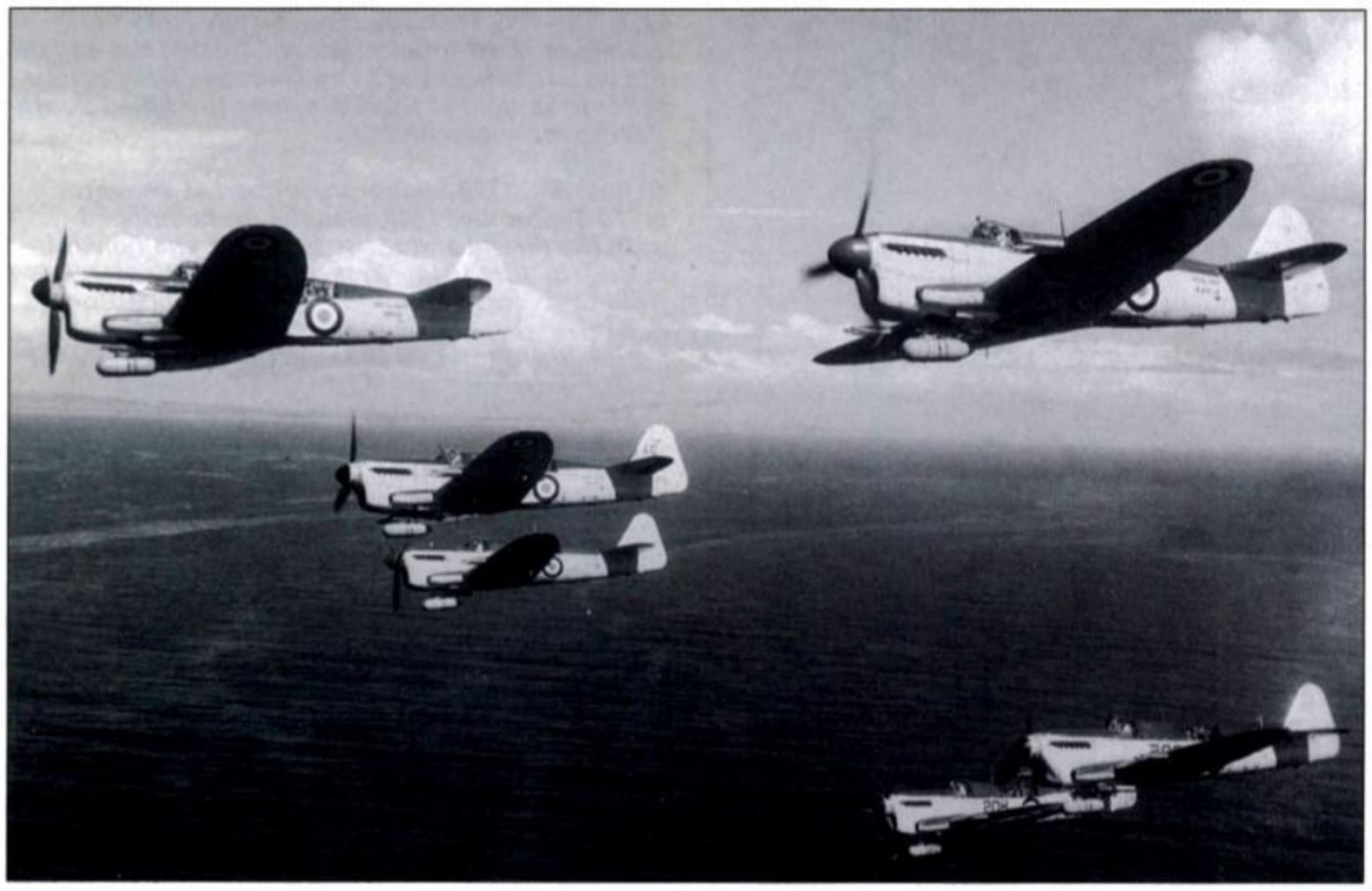
During the war an attempt had been made to increase performance by installing a 1,540-bhp (1150-kW) Griffon 61 in a Mk I airframe, Z1835. A large annular-type radiator was fitted below the nose but the aircraft proved to be directionally unstable. The aircraft was then redesigned with the radiator and oil coolers transferred to the leading edge of the centre-section, the wings were 'clipped', a Griffon 74 giving 2,100 bhp (1567 kW) was installed driving a four-bladed propeller, and the fin and rudder were reprofiled. A new member of the Firefly family was born, initially designated FR.Mk IV, but soon changed to FR.Mk 4.

Four prototype Mk 4s were flown, Z1835, Z2118, MB649 and PP482. The last of these conducted deck landing trials aboard HMS *Illustrious* and the first production FR.Mk 4, TW687, flew in May 1946. Some 43 Mk Is were converted on the production line to FR.Mk 4s, 77 were produced as 'true' FR.Mk 4s and 133 were cancelled in favour of the Mk 5 programme. Mk 4s were first issued to No. 825 Squadron in August 1947, followed by Nos 810, 812, 814, 816 and 1840. The variant had a relatively short service career, replaced on the production line the following year by the Mk 5. Twenty-eight were converted to fulfil the target-towing role, fitted with an ML Type G winch under the centre-section; these were known as TT.Mk 4s. In addition, 40 FR.Mk 4s were sold to the Dutch Navy in February 1947.

Universal airframe

With the introduction of the FR.Mk 4, it was recognised that the Firefly could now fulfil a number of different roles, eliminating the

Just too late for service in World War II, No. 1792 Squadron (motto: 'Nocte vincimus'/We conquer by night) was one of the three dedicated Firefly night-fighter units formed near the end of the conflict. Here a number of the unit's NF.Mk Is prepare to leave HMS* Ocean*, sometime in 1946. After a cruise in the Mediterranean, the unit disbanded the following April upon* Ocean*'s return to the United Kingdom.



Left: Brighter colours, Type 'D' roundels and large underwing serials adorned Fireflies of the peacetime Fleet Air Arm. The 'AC' code on the tail of the second of these Firefly FR.Mk 1s denotes a shore base at Abbotsinch, from where these machines flew with No. 1830 Squadron, RNVR. Seen here during 1951, these were among the last Mk 1s in FAA service.

Below: With Fairey-Youngman flaps and gear down and its cockpit canopy rolled back, F.Mk 1 MB500 approaches a shore base.

need for a range of different airframes. Thus, the FAA drew up a requirement for an aircraft to do just that, the Mk 5 being the result. This was offered with a 'universal' airframe able to be relatively quickly adapted for fighter-reconnaissance, anti-submarine and night-fighter tasks. (The actual physical changes for the first two roles took only a short time; to convert a Mk 5 for night-fighting took something like three hours!) The first production Firefly Mk 5, VT362, made its maiden flight on 12 December 1947 from White Waltham and was delivered on 9 January 1948. The last of 352, WB440, was delivered on 19 May 1950. No. 814 Squadron was the first to re-equip with the variant, followed by Nos 810, 812, 817, 820 and 825 Squadrons. (No. 821 Squadron also exchanged its Firefly AS.Mk 6s for FR.Mk 5s before taking part in the Korean War.)

Korean operations

When the Korean War broke out on 25 June 1950 the British aircraft-carrier HMS *Triumph* was sailing in Far Eastern waters, and within five days was at action stations off the Korean coast. On board was the 13th Carrier Air Group consisting of No. 827 Squadron with Firefly FR.Mk 1s and No. 800 Squadron with Seafire FR.Mk 47s. On 3 July the air group attacked Haeju airfield using RPs and cannon. From then on, until the ceasefire in July 1953, one British, Australian or American carrier was continually operating in support of United Nations forces ashore.

As the Fleet Air Arm lacked a maintenance facility ashore, the base at Sembawang, Singapore was set up utilising the repair section of the supply carrier, HMS *Unicorn*, which included workshops, stores and spare aircraft.

UN forces, especially those from the US, had difficulty distinguishing UN piston-engined aircraft from the Yak-9s and other piston types of the North Koreans. This was brought to a head on 28 July when a USAF B-29 shot down a Seafire of No. 800 Squadron. All FAA aircraft were then painted with black/white stripes around the wings and fuselage to aid identification. Another problem was the limited range of British aircraft – usually no more than 150 miles (240 km) – which restricted their usefulness. Although they attacked targets available to them, FAA crews found that they were being used more for combat air patrol and anti-submarine patrols. When a British carrier reached the end of an operational period, it was usually relieved by an American carrier, such as USS *Bataan*, and the two then operated an 18-day cycle alternately.

Mk 5s aboard *Theseus*

The dilemma of limited endurance was resolved when HMS *Theseus* arrived to relieve *Triumph*, as the ship had the 17th CAG on board with Firefly Mk 5s and Sea Furies, both of which had increased range and could be catapulted off with a bomb load. The Fireflies were found to be excellently suited to the dive-bombing role and performed this duty throughout the war. In a region in which the climate presented problems like monsoons, snow, fog and generally poor visibility, their extensive achievements were entirely due to the high standards set and maintained during peacetime training.

The activities of the 17th CAG give some idea of the capabilities of a small British carrier's air group. During the 10 operational periods between 18 August 1950 and 19 April 1951, this air group flew 3,446 sorties and expended 6,617 RPs, 1,390 500-lb (227-kg) bombs, 84 1,000-lb (454-kg) bombs, 76 depth charges and 523,220 rounds of 20-mm ammunition. More than 1,100 enemy targets were destroyed, and as many damaged. Unless the weather interfered, the number of sorties flown per day was never fewer than 50, and 1,000 accident-free deck landings were made.

In April 1951 *Theseus* was relieved by HMS

Firefly FR.Mk I MB750 was made available by the Admiralty for conversion as the first Firefly Trainer. The aircraft never carried its allotted civil registration, G-AHYA, and instead used the Fairey factory identity of F1. Finished in the company's house colours – silver and blue – this machine was the forerunner of a number of dual-control Mk 1, 2 and 5 conversions, some of which were carried out overseas. MB750 was eventually refurbished as a T.Mk 2 and sold to the Royal Thai Navy.

The Royal Australian Navy eventually took delivery of 108 Fireflies of Mks 4, 5 and 6, the first of which were operated from HMAS Sydney (ex-HMS Terrible). This formation represents Nos 816 and 805 Sqns with Firefly FR.Mk 4s and Sea Fury FB.Mk 11s, respectively. The nearest of the Firefly trio carries a Type 'D' fuselage roundel and no fin flash, while the other aircraft have Type 'C' roundels and fin flashes of the type introduced during the war years. The 'JR' codes carried by the aircraft indicate RNAS Eglinton, the squadrons' base at the time of their reformation as RAN units in 1948. Australia retired its last Firefly, flown by No. 724 Squadron, in March 1966.

Glory with the 14th CAG aboard, consisting of No. 812 Squadron with Firefly Mk 5s and No. 804 with Sea Furies.

After completing 2,892 operational sorties, *Glory* was relieved by the Australian carrier HMAS *Sydney*, which had No. 817 Squadron with its Firefly Mk 5s, plus Nos 805 and 808 squadrons flying Sea Furies. Starting operations on 4 October 1951, its aircraft attacked various bridges. The Fireflies, usually flying in sections of four, carried two 500-lb (227-kg) bombs.

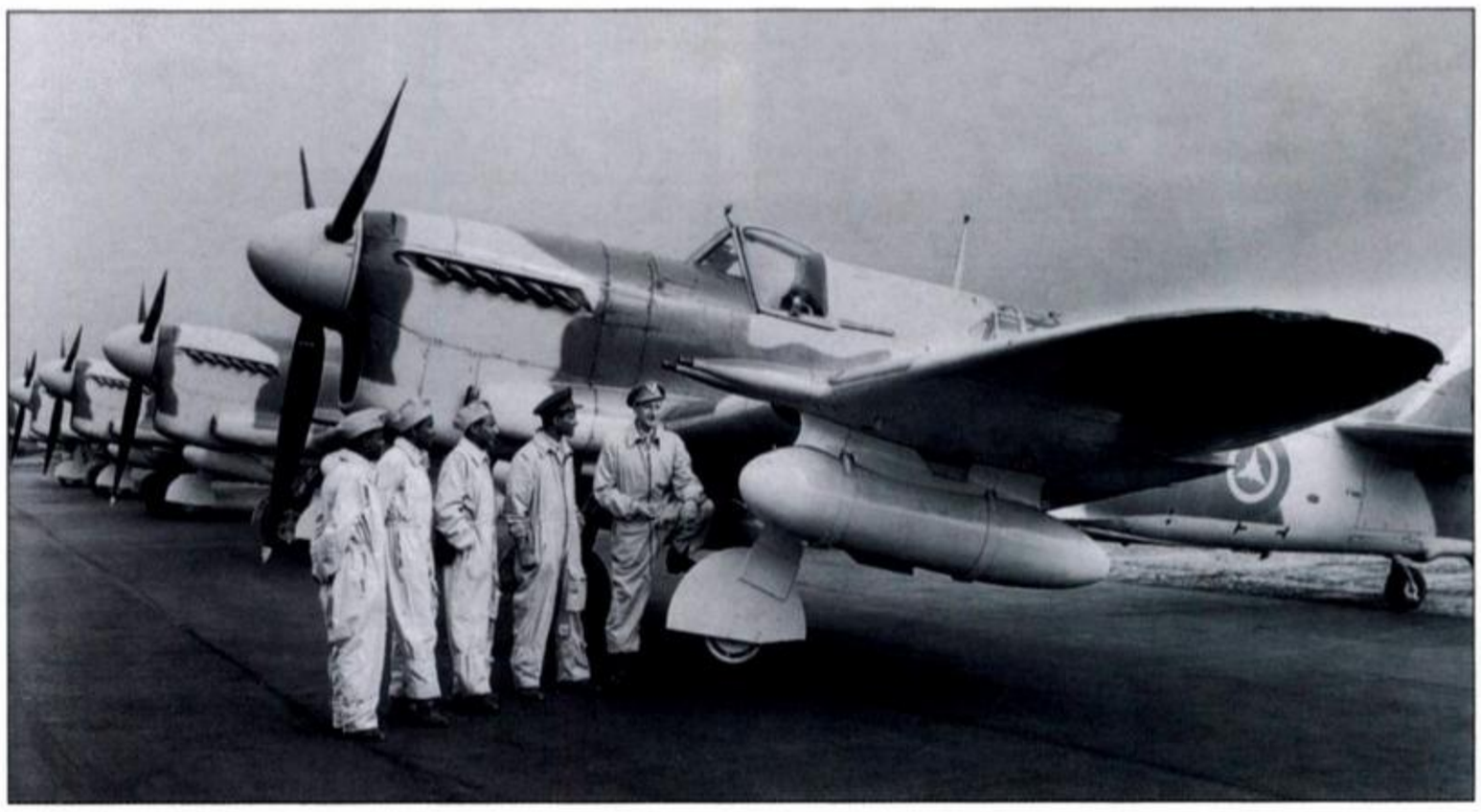
Downed Firefly crew rescued

Aircraft were lost to flak and ground fire, but very little was seen of North Korean aircraft, piston-engined or jet-powered. On 25 October five Fireflies went after a rail tunnel south of Sariwon but ran into intense flak, and one pilot force-landed in enemy territory. With Sea Furies as cover, the *Sydney*'s Dragonfly helicopter, on loan from the Americans, was sent to try to get the crew out. The Firefly crew was holding the enemy at bay with Owen sub-machine-guns, but only just; the enemy were 45 ft (13.7 m) away when the helicopter arrived. One of the crew, C. G. Goulding, a USN crew member on loan with the helicopter, leaped out and killed two of the nearest enemy soldiers while the Firefly crew got aboard. The rescue was successful and one hour later the helicopter landed at Kimpo.

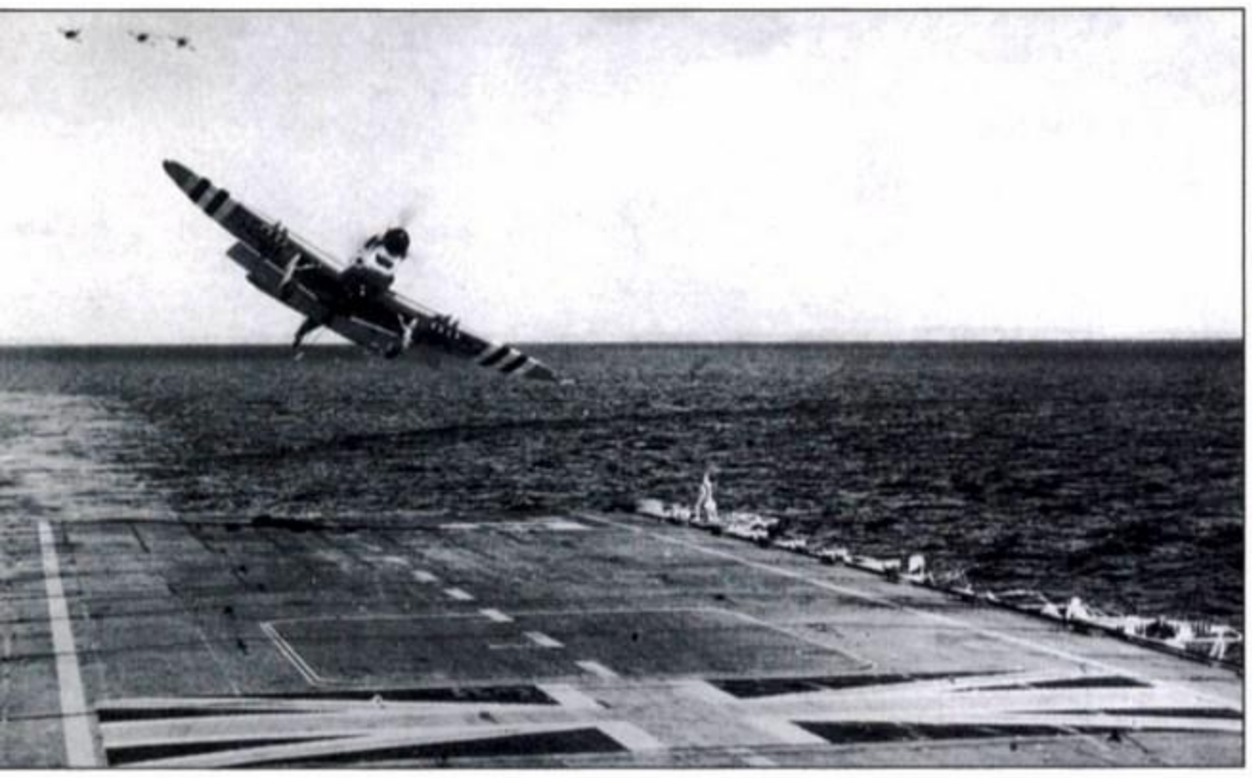
The weather over the next few weeks was poor, but strikes were undertaken whenever possible. When the tour of duty was finished, *Sydney*'s aircraft had flown 2,366 operational sorties, 743 by the Fireflies of No. 817 who delivered 1,118 500-lb (227-kg) and 10 1,000-lb (454-kg) bombs. They were replaced by HMS *Glory* for one series of strikes between February and April 1952, still embarking No. 812 with its Mk 5s.

In May HMS *Ocean* arrived with the 17th CAG embarked, consisting of No. 825 Squadron with Firefly 5s and No. 802 with Sea Furies. The air group failed to get off to a very good start, losing six aircraft to flak and other causes in the first few days. They kept the round-the-clock strikes going but were restricted to no more than 68 sorties a day due to a shortage of rockets and bombs. The type of operations the replacement air group found itself engaged in put the aircraft within the

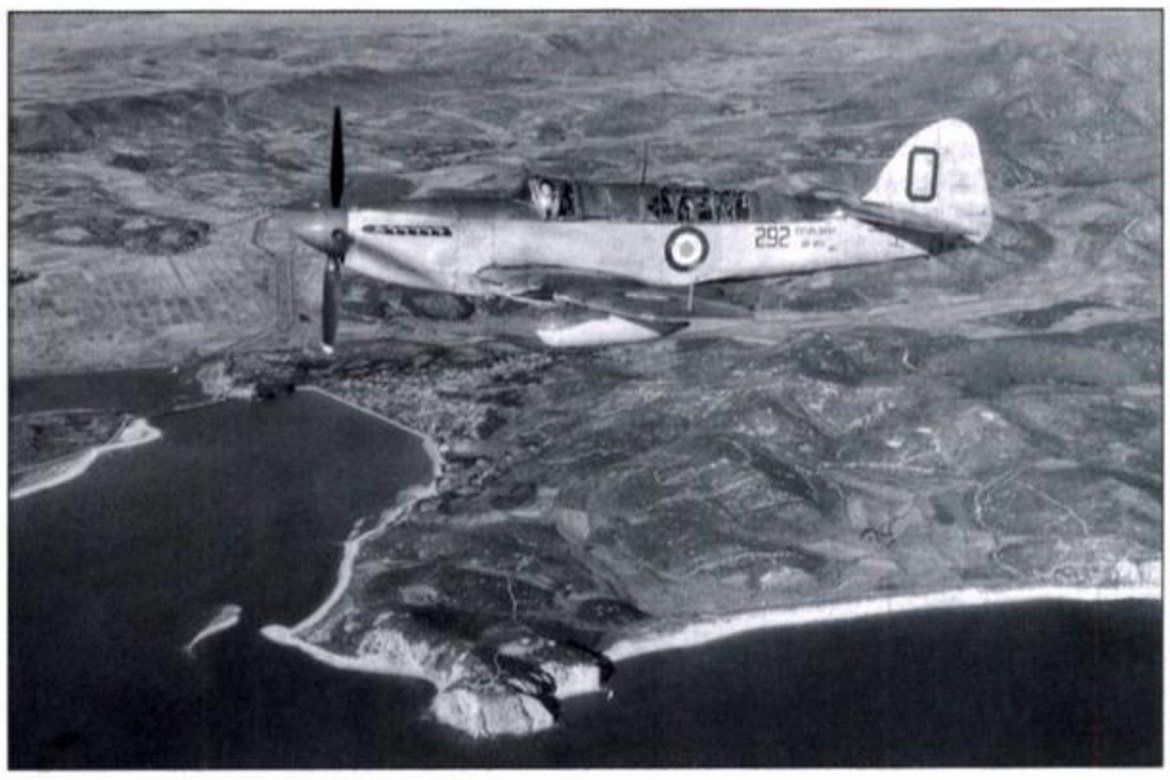
The Dutch navy was to operate the largest fleet of Fireflies outside the UK. The Royal Netherlands Naval Air Service's first aircraft were Mk Is delivered between January and June 1946. Here the first aircraft is seen with a number of its sister machines prior to their delivery, still in FAA camouflage, but with an orange national marking ahead of the cockpit (and, in this photo, out of site on the rudder) and 'Koninklijke Marine' and its new Dutch serial number (F1) stencilled ahead of the tailplane.



While the Fleet Air Arm re-equipped with new Firefly variants, some of the earliest Mk Is were refurbished for sale. After attempts to secure a batch of ex-RAF Halifaxes failed, the Imperial Ethiopian Air Force took delivery of eight ex-FAA FR.Mk 1s and a single T.Mk 2. These were augmented in 1954 by 14 aircraft from Canada (nine FR.Mk 1s, three T.Mk 1s and two T.Mk 2s). An additional nine aircraft believed to have been purchased from the Netherlands do not appear to have been delivered.



Firefly FR.Mk 1s served briefly over Korea. Here one of No. 827 Squadron's aircraft gets a 'wave off' from HMS Triumph. The union flag on the deck identified the carrier as a British ship assigned to the UN force off Korea.



With a large 'O' (for HMS Ocean) on its tail fin, this No. 825 Squadron Mk 5 lacks the usual identification stripes on its fuselage or wings. Towards the end of the war these markings were applied increasingly rarely.

range of enemy fighters. Four Fireflies of No. 825 were returning from a strike on 24 July, one of them damaged by flak, when they were attacked by four MiG-15s. Although none of the Fireflies was shot down, all were damaged by gunfire, one ditching in the sea west of Choda, its crew being picked up later.

More MiG skirmishes

On 9 August four Sea Furies were attacked by eight MiG-15s and in the ensuring melée Lieutenant P. Carmichael shot down one of the MiGs, for no loss to the Sea Furies. Over the next day or two, other strikes were attacked by MiGs, and on 11 August two Fireflies managed to shake off a similar attack. Other aircraft were lost to flak and it was with some relief in September when they handed over to HMS *Glory*, back for a third spell on operations.

The new air group consisted of No. 821 Squadron with Firefly 5s and No. 801 with Sea Furies. They were immediately in action using RPs and bombs against bridges, gun emplacements, river craft and enemy tank/vehicle parks. Nine Sea Furies and six Fireflies were all damaged by flak in one day, with one Firefly crash landing. On the following day gun emplacements on the coastal cliffs were totally destroyed by Fireflies dropping 1,000-lb (454-kg) bombs. At least three Fireflies were lost to flak in the next two weeks, plus a couple to deck landing accidents. On 4 March 1953 the Fireflies started to drop leaflet bombs as peace talks continued, but this in no way interfered with the normal business. *Glory* ended its spell on 14 May, its CAG having expended 8,768 RPs, 232 1,000-lb (454-kg) bombs, 841 500-lb (227-kg) bombs, 40 leaflet bombs, 20 depth charges and more than 230,000 rounds of ammunition.

On 17 May HMS *Ocean* returned with a new air group aboard, comprising No. 810 Squadron with Firefly Mk 5s, and No. 807 with Sea Furies. Attacks on enemy positions continued. On 8 June the President of South Korea rejected the ceasefire terms and two days later Communist ground forces launched a new attack against South Korea. Talks now centred around an armistice, and the UN command and North Korean forces agreed to carry on negotiations without the participation of the South Koreans.

Night-fighter detachment

It was during June that the US 5th Air Force requested HMS *Ocean* form a night-fighter detachment to be based ashore at Kimpo in an attempt to intercept enemy Polikarpov Po-2 biplanes. They were flying in at night to carry out so-called 'Bedcheck Charlie' nuisance bombing raids, which, while having little effect on the war as a whole, kept those on the ground on constant alert and were used to threaten the UN during the peace talks.

During July three Fireflies from No. 810 Squadron, fitted with APX-6 (IFF Mk 10), flew three two-hour patrols every night. Operating

Left: HMS Ocean steams toward the waters off Korea in July 1952, with the 17th Carrier Air Group aboard. No. 825 Squadron's 12 Firefly FR.Mk 5s are crammed in on the rear of Ocean's deck, behind 20 Sea Fury FB.Mk 11s of No. 802 Sqn. Four Royal Navy carriers joined a fifth from the Royal Australian Navy in operating Fireflies in support of United Nations ground forces during the Korean War.

Above: Somewhere off the Korean coast, a loaded FR.Mk 5 blasts along the deck of HMS Glory, with the aid of RATO rockets. Beneath its centre-section are what appear to be sonobuoys, while under the wings are 250-lb (113-kg) depth charges. It was not until the Mk 5 was made available to FAA units in Korea that they had sufficient range for the air-to-ground sorties with which they were tasked.

Without the benefit of RATO, a 'bombed-up' FR.Mk 5 needed a wind speed of 21 kt (39 km/h) over the deck to get airborne; a fully-laden Sea Fury needed 28 kt (52 km/h). This Mk 5 is about to reach the end of the catapult on HMS Glory.

under American ground control, they flew racetrack patterns between Inchon and Seoul. Although no positive interceptions were made, a number were carried out against unidentified radar blips, and it is perhaps significant that there were no Po-2 raids while the Fireflies were operating.

On 27 July 1953 an armistice was signed at Panmunjon. After completing its spell of duty, *Ocean* returned to the UK. *Sydney* returned to carry out peacekeeping patrols during 1953/54, after which carrier involvement and that of the Firefly ceased. Once again the Firefly had made a considerable contribution during its second wartime commitment.

A redefinition of role

The initiation of a change of role for the Firefly came when the Admiralty asked Fairey to consider fitting American sonobuoys to the AS.Mk 5. After various trials, a number of changes were suggested along with a change of designation. During the war and in the immediate post-war era the emphasis had been very much on submarine detection. The role of the Firefly AS.Mk 5 as it stood revealed certain limitations, and changes were needed.

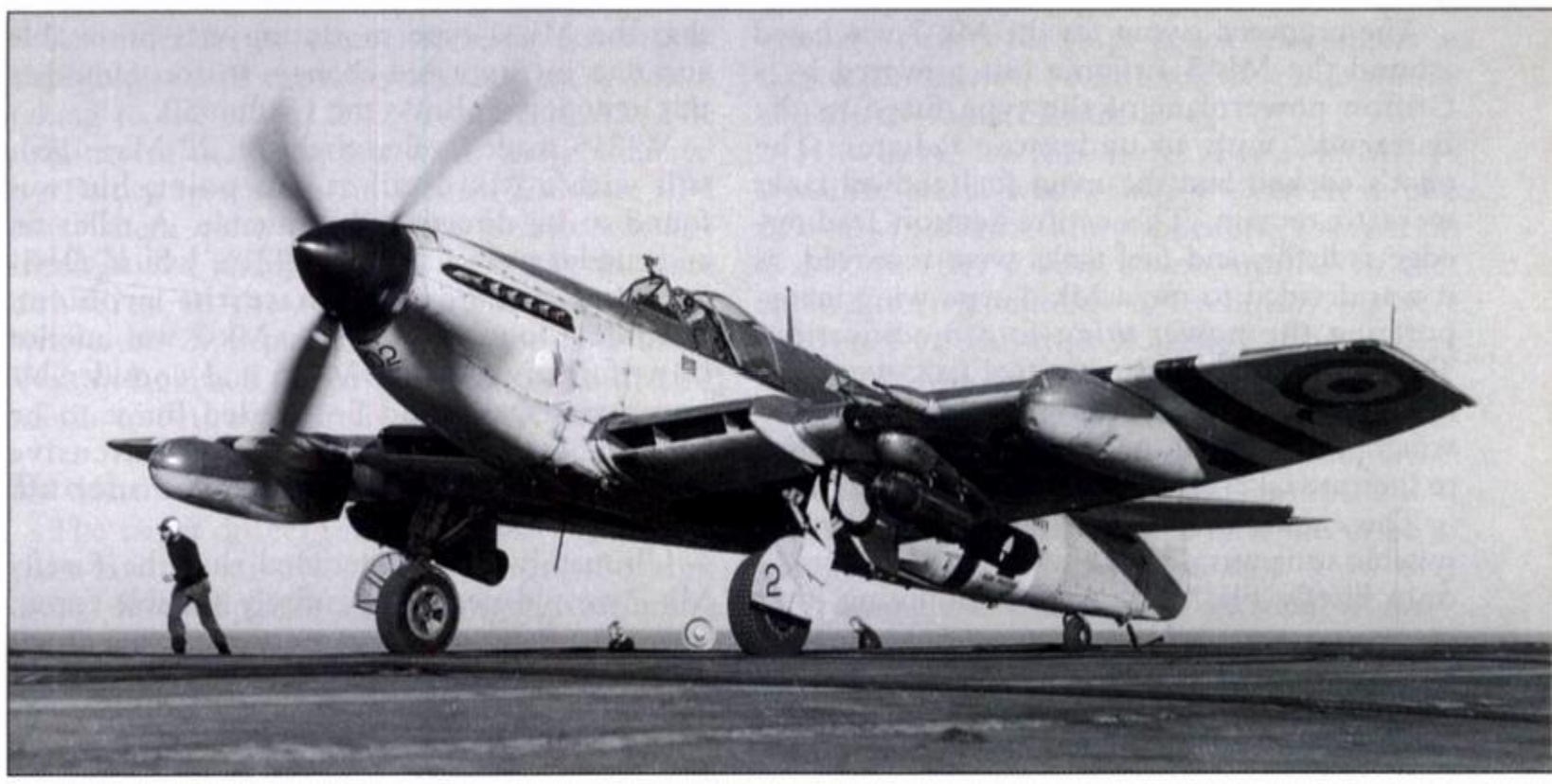
Although the new version of the Firefly was to be the AS.Mk 6, the Ministry also decided that any Mk 5s on the production line at the time of the Mk 6 order were to be completed to Mk 6 standard. This also included Mk 5s not in front-line service. Some 131 were earmarked for conversion, but events overtook this plan and only 56 were so-treated. The reductions came as the Ministry realised that these aircraft would still differ from 'true' Mk 6s in several important respects.

The main differences between Mks 5 and 6 were the incorporation of a longer undercarriage leg, deletion of wing guns and provision to carry a wider variety of both British and American stores. Firefly WB251 became the trials aircraft, WB423 was the first modified Mk 5 and WB505 was the first true AS.Mk 6, the latter machine flying for the first time on 23 March 1949. In January 1951 No. 814 Squadron became the first to receive the AS.Mk 6.

No. 814 and No. 809 Squadron, with Sea Hornets, became the 7th Night Air Group – the FAA's first all-weather unit to operate from a carrier. HMS *Vengeance* was the carrier chosen for the trials and the group embarked in May 1951. No. 814 went on to achieve 927 night-flying hours in the new AS.Mk 6 and that year won the Boyd Trophy. Other RN squadrons that flew the Mk 6 were Nos 812, 820, 821, 824 and 826, plus Nos 1830, 1840, 1841 and 1844, RNVR. At least 11 second-line units operated the AS.Mk 6, along with three first-line Australian units, Nos 816, 817 and 851. Throughout the early 1950s the Firefly

The unloved Mk 7, with its large chin intake and huge tailfin, served the FAA only in a training capacity. Over 300 anti-submarine Mk 7s were ordered, but fewer than half were delivered, some straight into storage. The final 24 built were completed as U.Mk 8 drones, the last of these, WP354, being the 1,702nd airframe.

Below: Sporting a pair of 1,000-lb (454-kg) bombs, a Mk 5 prepares to take the catapult on another air-to-ground sortie. The ASH radar pod, usually fitted to the starboard wing, was often deleted for Korean operations and replaced with another fuel tank.



AS.Mk 6 was the standard aircraft for the anti-submarine role, but its operational life was comparatively short. By the mid-1950s it was being replaced by its Fairey stablemate, the Gannet.

Ill-fated Mk 7

Another interim anti-submarine aircraft, designated Firefly AS.Mk 7, was under development and was to be operated by a crew of three. A Naval Staff Requirement of June 1949 called for a three-seat version of the AS.Mk 5 to be introduced for service aboard light carriers, for which the Fairey Gannet was going to be too heavy. The new Firefly, though having a greater all-up weight than earlier variants, was light enough to fit the bill.

Fairey was less than enthusiastic about the three-seater requirement, but allotted Firefly FR.Mk 1 MB757 as a mock-up and flight trials aircraft. Problems lay in the demand for space for the third crew member, and the required redesign turned the Mk 7 project into some-

The last British Fireflies were drones like this U.Mk 9 (WB341/'593'), photographed (minus its camera pods) under a threatening sky while being refuelled at Hal Far. Operated by No. 728B Squadron, '341 was one of the first drones delivered to the unit in 1958. The last Mk 9 drone was shot down in 1961, bringing the FAA's association with the type to a close.

thing of a disaster. The Admiralty ignored warnings from Fairey and announced that it required at least 50 aircraft initially. Eventually, some 337 were ordered, although there was no real need for so many. In fact, of those delivered, a number never saw squadron service and sat at storage depots until being broken up.

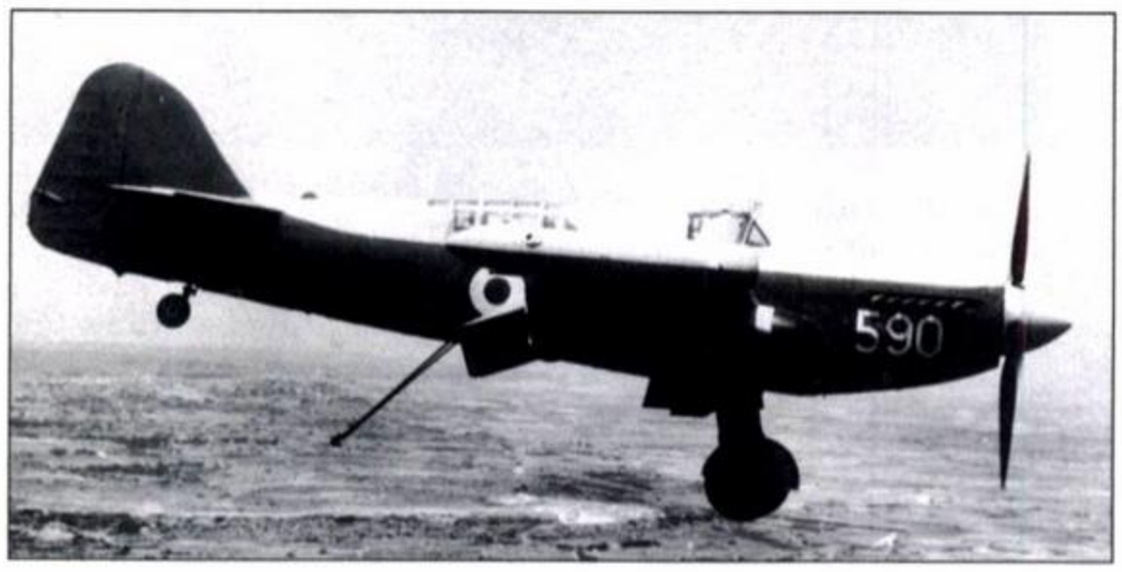
Mk 5 layout

The proposed layout for the Mk 7 was based around the Mk 5 airframe but powered by a Griffon powerplant of the type fitted to the Barracuda, with an undernose radiator. The pilot's cockpit and the main fuel and oil tanks were to remain. The centre-section leading-edge radiators and fuel tanks were removed, as it was decided to use a Mk 4-type wing incorporating the power wing-fold modification. The ASH nacelle and extra fuel tank would be mounted on the outer portion of the wing, and wingtips like those on the Mk 1 were reinstated to increase take-off and cruise performance.

The engine originally selected was not really suitable so it was decided to install a Griffon 12 on a Firefly FR.Mk 4 engine mounting, thus moving the engine 5 in (12.7 cm) forward. Apart from the test aircraft, MB757, two other prototypes were ordered – two Mk 6 aircraft, WD924 and WD925 – which were given the new serials WJ215 and WJ216, respectively. It was felt that these three machines would adequately fill test flying requirements. Rolls-Royce eventually supplied a different engine with single-stage supercharging, but declared that the Mk 4-type mounting was unsuitable and thus incorporated changes to accommodate this new powerplant – the Griffon 59.

WJ215 made its first flight on 22 May 1951, still with a Mk 6 tail at this point, but was found to be directionally unstable. A taller fin and rudder were fitted to WJ216, which alleviated but did not eliminate the problem. According to test reports, the Mk 7 was inferior in performance to the Mk 6 and considerable improvements would be needed for it to be acceptable for use in the FAA. Extensive redesign was carried out but performance was little improved.

Ultimately, it was decided that the Firefly Mk 7 would never be entirely suitable for its specified role, particularly at night. Instead, it was decided to accept a limited number of the Firefly Mk 7s as trainers and offer other airframes to the Guided Weapons Development Squadron (GWDS) for development as target drones. The first production T.Mk 7, WJ146 made its maiden flight on 16 October 1951 The production order was reduced to 151 machines, of which 110 were built at the Hayes factory and 41 at Stockport. The T.Mk 7s entered service with training units, starting with No. 719 Squadron at Eglinton in February 1953. By 1957 they had all been replaced in service by the Gannet trainers.



With its undercarriage, hook and flaps down, but with no-one aboard, U.Mk 9 VT487 is seen here in NOLO (NO Live Operator) condition on a flight from Hal Far, probably in July 1958. Operated by No. 728B Squadron in Malta, most Mk 9s fell to Armstrong Whitworth Seaslug surface-to-air missiles, AA guns or Firestreak air-to-air missiles fired from the Sea Venoms of No. 893 Squadron, also in Malta.

Training 'Firefliers'

Towards the end of World War II the authorities recognised that the practice of merely sitting new pilots in a single-seat fighter after a few hours in a North American Harvard or Miles Master was contributing factor in the high accident rates of the period. Manufacturers hurriedly produced dual-control versions of such types as the Spitfire, Master, Firefly and, later, the Sea Fury.

Fairey modified FR.Mk 1 MB750 by installing a second cockpit where the observer's station had been, at the same raising it 12 in (30 cm) to give the instructor a decent view. To expedite development, a second aircraft, Z2033, was converted and became the first to fly, on 29 May 1946, with Sam Moseley at the controls. MB750 followed on 21 June, finished as a company demonstrator in silver and blue with company serial 'F1' carried on the fuselage. Z2033 was completed in trainer yellow with Fairey's B-Class test code 'G-6-3'.

Orders were soon received from an enthusiastic Admiralty for 34 T.Mk 1 trainers, all to be conversions of F./FR.Mk Is currently in service. Six of these had one 20-mm in each wing for weapon training. The first T.Mk 1 was MB473, which flew in its new guise on 23 July 1947. As a follow-up, the Admiralty asked for full weapon training facilities and 54 Firefly F./FR.Mk Is were converted by Fairey at its Stockport factory. Known as T.Mk 2, they had one 20-mm gun in each wing, gyro gunsights in the front cockpit, and weapon stations under the wings. The first production T.Mk 2 flew as such on 12 August 1949. These trainers were a godsend for the FAA and, apart from being used by training units, saw service with most front-line squadrons, each having at least one

The last of 34 Firefly U.Mk 8 drones was delivered on 20 April 1956 and brought Firefly production to an end. WM882 was one of the Mk 7s completed by Fairey to drone standard.

In Australia, ex-Royal Australian Navy Firefly Mk 6 WD826 is maintained in an airworthy condition. Reduced to an instructional status in 1964, the aircraft joined the Naval Aviation Museum at NAS Nowra in 1974. Restored to flying condition, it flew again in October 1986, marked 245/'K' (as an aircraft based aboard HMAS Sydney) and finished in the immediate post-war Fleet Air Arm colour scheme in which it would have been delivered to the RAN in 1953.

Canadian Warplane Heritage is the keeper of airworthy Firefly Mk 6 WH632, originally restored to flying condition during the early 1990s to replace another Mk 6 (WD901) restored to fly but tragically lost in a fatal crash in 1977. '632 also came to grief, damaged in a take-off accident on its delivery flight in 1992. Flown again in 1996, registered C-GBDG, this is another ex-RAN aircraft, finished in the colours and markings of the AS.Mk 5s flown by No. 825 Sqn, RCN (later renumbered No. 880 Sqn).

example on strength for dual/instrument flying and general training.

In 1949, as a follow-on, the Admiralty approached Fairey about devising a conversion kit that would allow the use of surplus Firefly Mk Is for observer training. No physical changes to the basic layout were required, the main difference being the fitting of special equipment in the rear cockpit for anti-submarine training. Approximately 50 examples were converted, and items not required, such as armament and deck arrester hook, were removed. Designated T.Mk 3, the conversions were mainly undertaken at NAS Fleetlands by Fairey work parties from Ringway. The first was PP411, and all the conversions fell in the PP serial range; they were converted during 1949-51. No. 796 Squadron became the first, and main, operator of the T.Mk 3, although the RNVR squadrons – Nos 1830, 1831, 1833, 1841 and 1844 – also received examples. The aircraft were phased out from June 1953 when the first T.Mk 7s arrived.

Drones

One of the most exciting phases of the Firefly's career came when it was almost over. The Ministry had recognised a need for aircraft converted as high-speed target drones for the testing of new missiles. When the Firefly AS.Mk 7 programme foundered, it was decided to use some of the aircraft already in production for which there was no requirement. In 1952 six Mk 7s were allocated for the new role, the work being undertaken by Fairey in conjunction with the RAE at Farnborough.

The pilot's cockpit would remain unaltered except for small changes, as the plan called for pilot operation at times. The rear cockpit was stripped of all existing equipment and a Type 'H' autopilot installed with radio control units and test instrumentation. To save weight, items like the wing-folding mechanism, exhaust flame dampers, water/methanol system and heaters were removed. Five cameras were carried in special nacelles mounted at the wingtips.

An order for 34 conversions, far fewer than expected, was received, with the first U.Mk 8 taking to the air on 27 November 1953. The majority of the flight test work was conducted by Fairey test pilots at White Waltham. To make them more visible, each aircraft was finished in red and yellow. The U.Mk 8s were delivered to the RAE's GWDS, Llanbedr where, on 29 September 1955, a de Havilland Venom launched the first guided and controlled missile to destroy a Firefly U.Mk 8 (WM886).

Banshee versus Firefly

The target drones proved popular with more than British missile manufacturers. Foreign armed forces began to show interest, including the Royal Canadian Navy, which came with its McDonnell F2H Banshee aircraft and shot down five of six Firefly drones with Sidewinder missiles. It was soon realised that the 34 drones would quickly be expended, and a second order for 40 was raised. In addition, the Navy became interested in acquiring drones, some for use as gunnery targets for ships at sea, and others as targets for the new Seaslug surface-to-air missile and the air-to-air Firestreak.

However, by this time very few Mk 7s remained and it was decided to convert surplus Mk 5s instead. They became known as U.Mk 9s after a conversion similar to that applied to create the Mk 8. Eventually, 40 were delivered by Fairey at Ringway, from where the first U.Mk 9 flew on 13 December 1956.

To operate the aircraft the RN formed a special unit at Stretton, No. 728B Squadron, on 13 January 1958. With training completed it moved to Hal Far on Malta, which was to be its base. At least 17 drones were shot down over the ensuing months, until 27 November 1961, when the last Firefly U.Mk 9, WB391, was shot down by the guns of HMS *Duchess*, ending another era in the FAA.

William A. Harrison

The Royal Navy Historic Flight's Firefly Mk 5 (WB271) is perhaps the best known (and was for many years the only) airworthy example, with a warbird career almost as long as its time on active service. Having served with the RAN, it was sold for A$400 in 1966 and shipped to the UK for presentation to the FAA Museum. Restored to fly again in 1972, the aircraft has carried the code '204' for some years, here with the deck letter 'R' for HMS Glory.

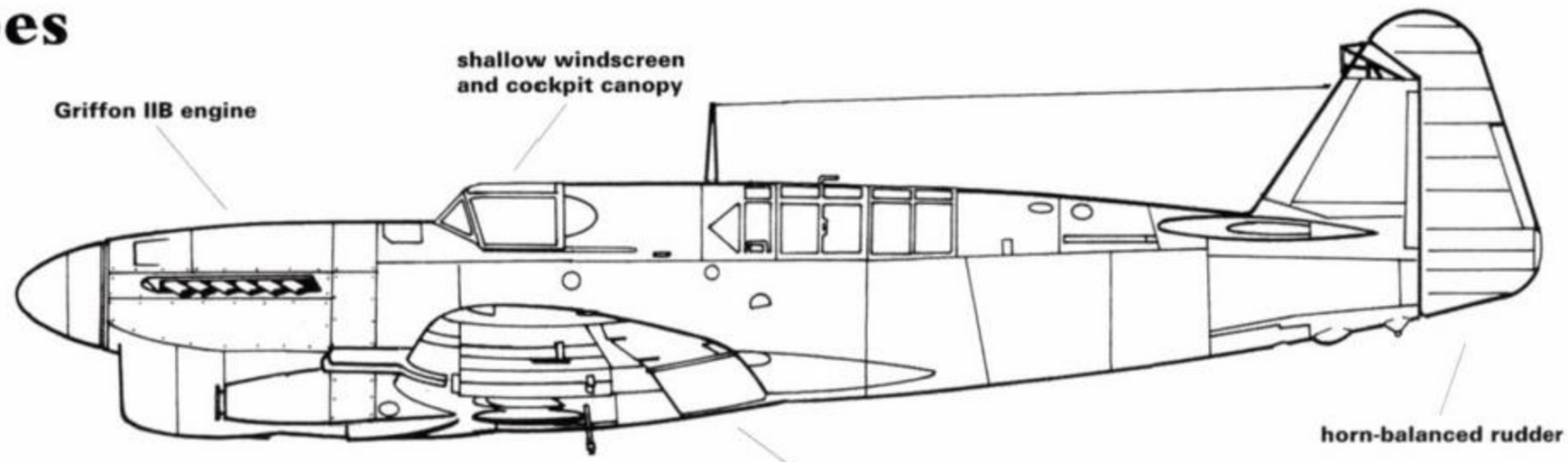
Fairey Firefly Variants

Firefly prototypes

Four prototype Fireflies were ordered – Z1826, Z1827, Z1828, Z1829 – for the flying and development programme, with Z1829 allocated to the RAE Farnborough as a structural test airframe. All four were hand-built in the experimental shop at Fairey's Hayes factory. Assembly was completed at the Great West Aerodrome (GWA), Fairey's private airfield located on the Great West Road (eventually absorbed into London's Heathrow Airport). The first prototype, Z1826, was rolled out late in December 1942, in natural metal finish. Its first flight was carried out by Fairey's chief test pilot, Flight Lieutenant Chris Staniland, on 22 December 1942.

The fuselage of this aircraft, and subsequent Fireflies, was built of two halves which came together along a vertical centreline and had no longitudinal stringers. The flush-rivetted light alloy monocoque fuselage gained its strength from 21 U frames and a centre-section with front and rear spars. Wing outer sections were hinged at the root ends of the rear spar so that each wing could be folded back along the fuselage. The tailplane and fin were also flush-rivetted and faired into the rear fuselage with fillets. The rudder and elevators were horn balanced and fitted with trimming tabs. All control surfaces were fabric-covered.

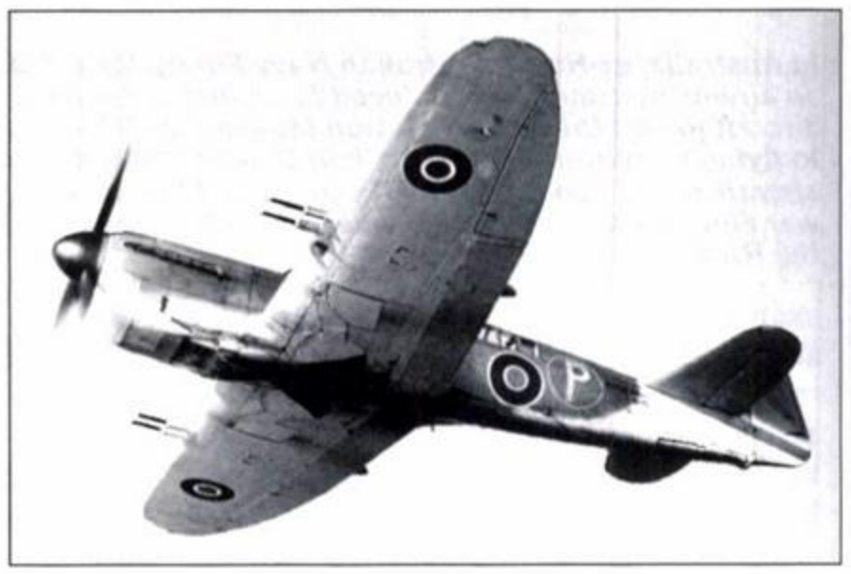
The undercarriage retracted inwards to lie in the centre-section. As a naval aircraft it had deck arrester gear in the form of a hook mounted at the bottom of frame nine, and four catapult spools, the two front ones being retractable and two others stowed in the fuselage when not in use. The pilot's cockpit canopy was aligned from the top of the windscreen and the top fuselage decking, creating an uninterrupted line to the tail. The observer's cockpit hood was completely faired in, with access by a panel hinged on the port side.



Firefly prototype

Flight Lieutenant Staniland flew the second prototype, Z1827, for the first time on 4 June 1942, but on 26 June this aircraft crashed, killing him.The cause of the accident was never fully understood but it was attributed to failure of the fabric-covered elevators, causing the collapse of the tailplane in up-load. The third machine, Z1828, became the test and trials aircraft for the Firefly programme that included deck-landing trials aboard HMS *Illustrious*. Z1829, destined to go to the RAE as a structural test airframe, was retained to replace Z1827 in the flight test programme.

Right: Z1826 was later finished in full wartime camouflage, with appropriate 'P for prototype' markings, lost its horn-balanced rudder and gained a set of four 20-mm Hispano cannon.



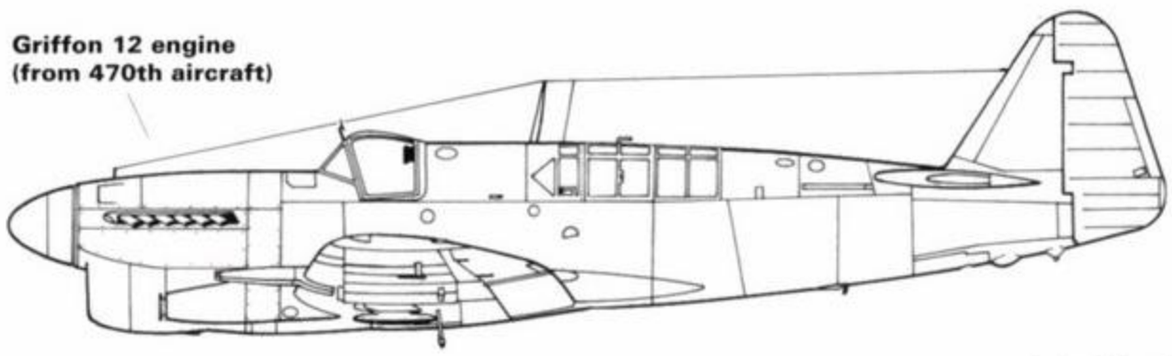
Left: Z1826 at the Great West Aerodrome is seen here shortly after completion in December 1941. Note the fabric-covered control surfaces, which soon gave way to metal-skinned equivalents after the fatal crash of the second prototype.

Firefly F.Mk I

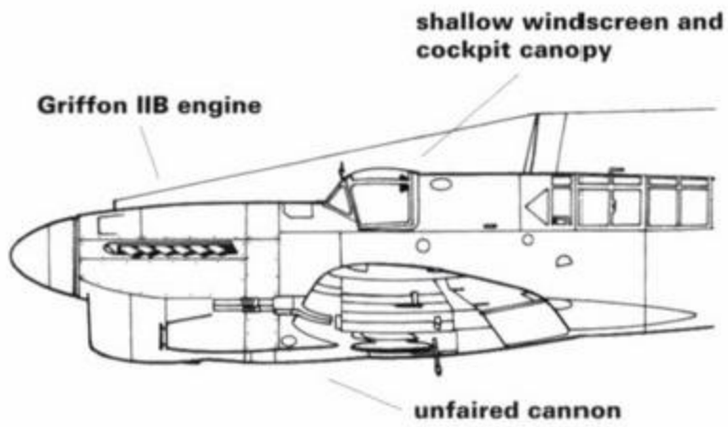
First production models were powered by the Rolls-Royce Griffon IIB driving a Rotol three-bladed, variable-pitch, constant-speed propeller. Starting was accomplished using a Coffman starter mounted on the starboard side of the engine. The powerplant (engine and associated systems) was arranged as a complete unit detachable from the firewall. The Griffon 12 replaced the IIB from the 470th aircraft onwards and became the standard engine for the early series of Firefly.

Armament consisted of four 20-mm cannon with 60 rounds per gun. Underwing stores included two 45- or two 90-Imp gal (205- or 410-litre) drop tanks to supplement the 192 Imp gal (873 litres) of fuel in the main tank and two auxiliary tanks in the leading edge of the centre-section. Two 1,000-lb (454-kg) bombs or equivalent stores could be carried, including, later, eight rocket projectiles (RP) arranged in tiers under each wing.

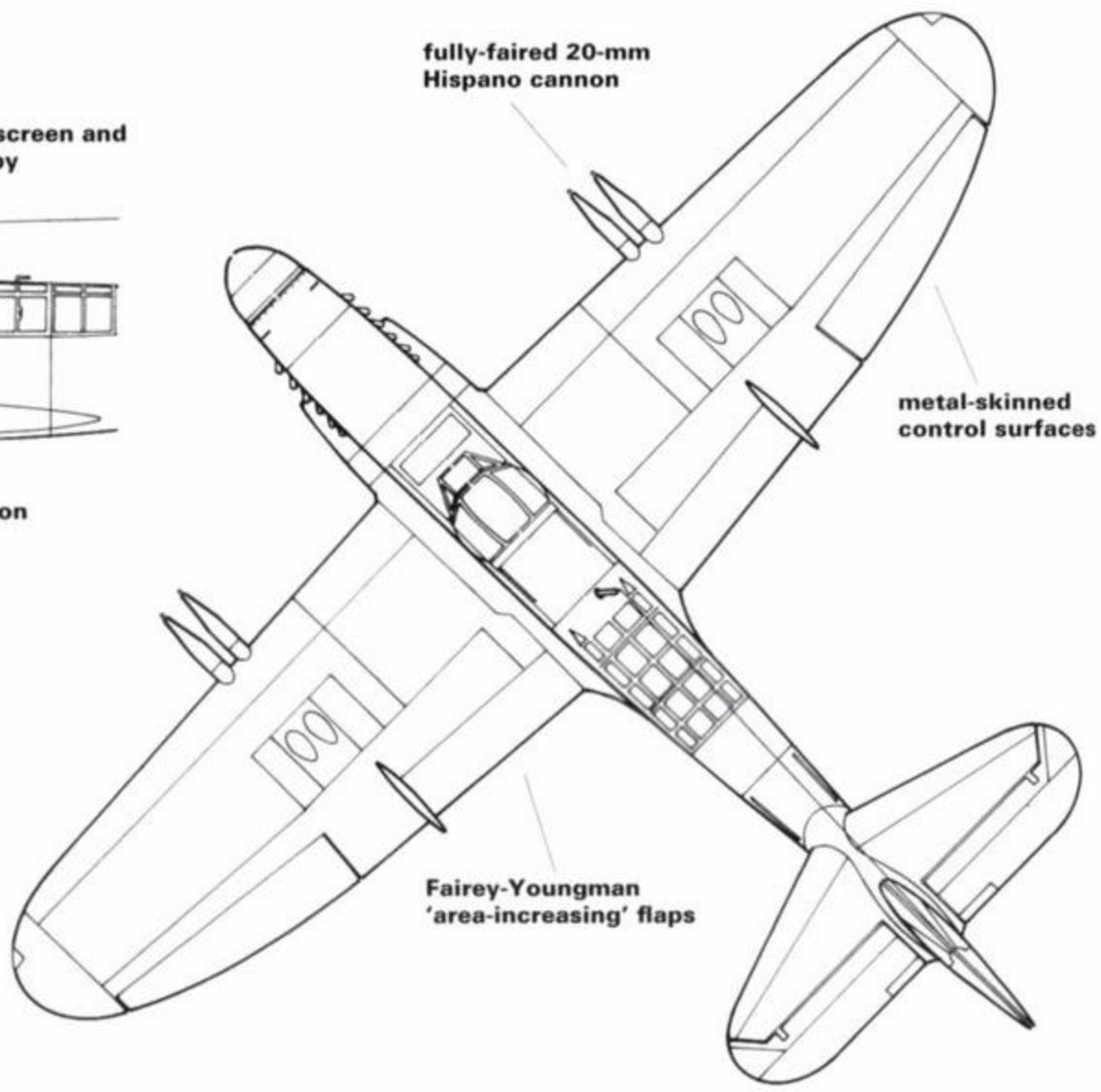
Total Mk I production reached 293, this figure including examples to FR.Mk I, NF.Mk I and NF.Mk II standard. All four variants were built on the same production line at the same time. Serial allocations for the Mk Is were Z1830-1845, 1865-1914, 1942-1986, 2011-2126, with Z2059, 2060, 2092, 2125, 2126 transferred to the Mk 4 contract as TW677, 678, 679, 687 and 688, respectively. Z2061-2091, 2093-2095, 2121-2124 were cancelled from the contract. DT926-928 were also cancelled, with DT929 and 930 being transferred to the Mk 4 programme as TW689 and 693. Also cancelled were DT931-949, 950-961, again transferred to the Mk 4 contract as TW694-699, 715-720. The remaining aircraft were serialled DT974-991, DV117-134, 147-150, PP391-437, 456-497, 523-567, 580-623, 639-660, MB378-419, 433-449, 460-479, 492-536, 549-593, 613-649 and 662-758. Of these, MB450-459 were cancelled and transferred to Mk 4 production as TW745-754. DK414-462, 476-513, 526-570 were built under sub-contract by General Aircraft Limited at Hanworth. The last 68 aircraft of the Mk I order – DK588-619, DK633-667 – were cancelled.



Firefly Mk I



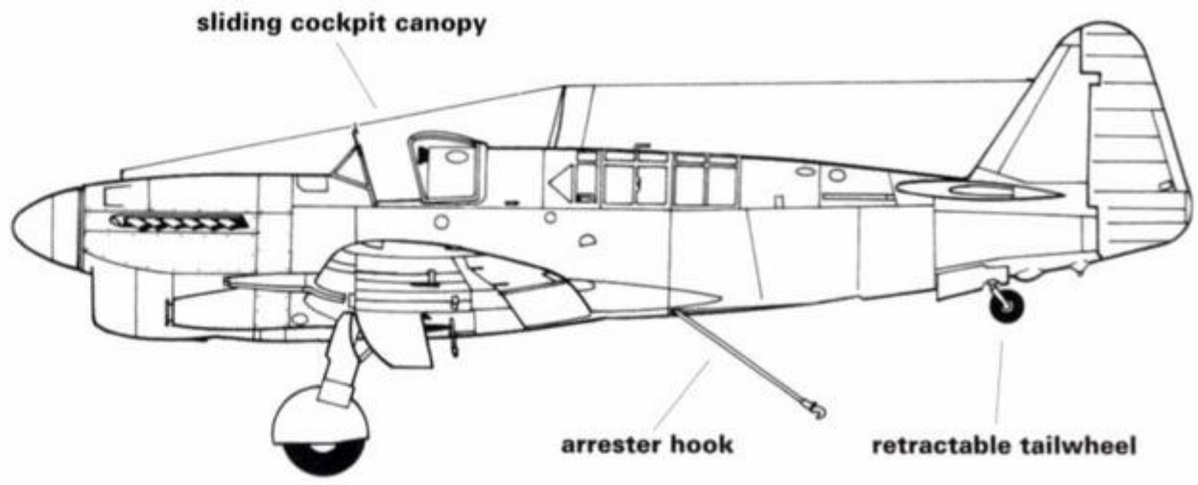
Firefly Mk I (early production)

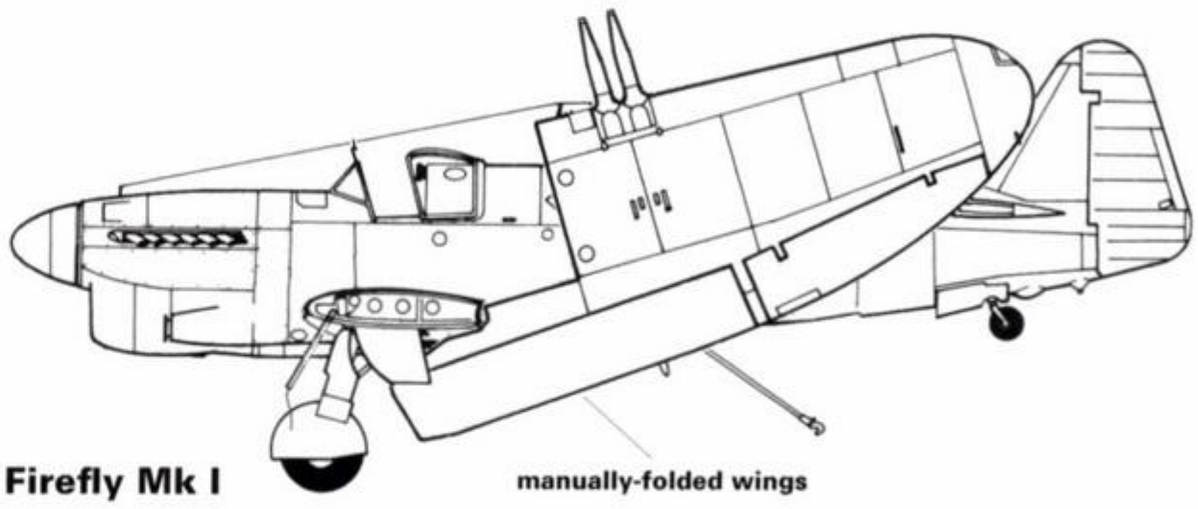


The first squadron to be equipped with the Firefly Mk I was No. 1770 at Yeovilton on 1 October 1943, this unit making its operational debut in July 1944 on sorties against the *Tirpitz*. No. 1771 followed on 1 February 1944 and No. 1772 on 1 May 1944. Plans for three other units – 1773, 1774 and 1775 – were shelved as the war drew to a close. Nos 816 and 822 Squadrons were also equipped, but saw no action. From October 1945 a further 11 squadrons received Fireflies – Nos 805, 812, 814, 824, 825, 826, 827, 837, 860, 861 and 1830.

Above: This view of Mk I Z1881 illustrates well the deployment of the type's Fairey-Youngman 'area-increasing' flaps.

Below: Production Mk I DT985 demonstrates the Firefly's load-carrying capabilities, here with two 1,000-lb (454-kg) bombs.





Firefly Mk I

Firefly F.Mk IA

This variant was an F.Mk I converted by RN MUs to FR.Mk I standard (using installation drawings supplied by Fairey) after which the aircraft were known as 'ASHCATs' or 'ASHCANs' in service. An installation test aircraft, Z1970/'G', was trialled with radar at A&AEE Boscombe Down from December 1944. The radar nacelle under the forward fuselage produced a directional oscillation problem which was never fully resolved. Aircraft were accepted by the FAA on the understanding that a fix for the problem would be found and applied once the aircraft were in service.

Records of the number of airframes converted to Mk IA standard, the first of which were released for service in March 1947, do not appear to have survived.

Firefly FR.Mk I

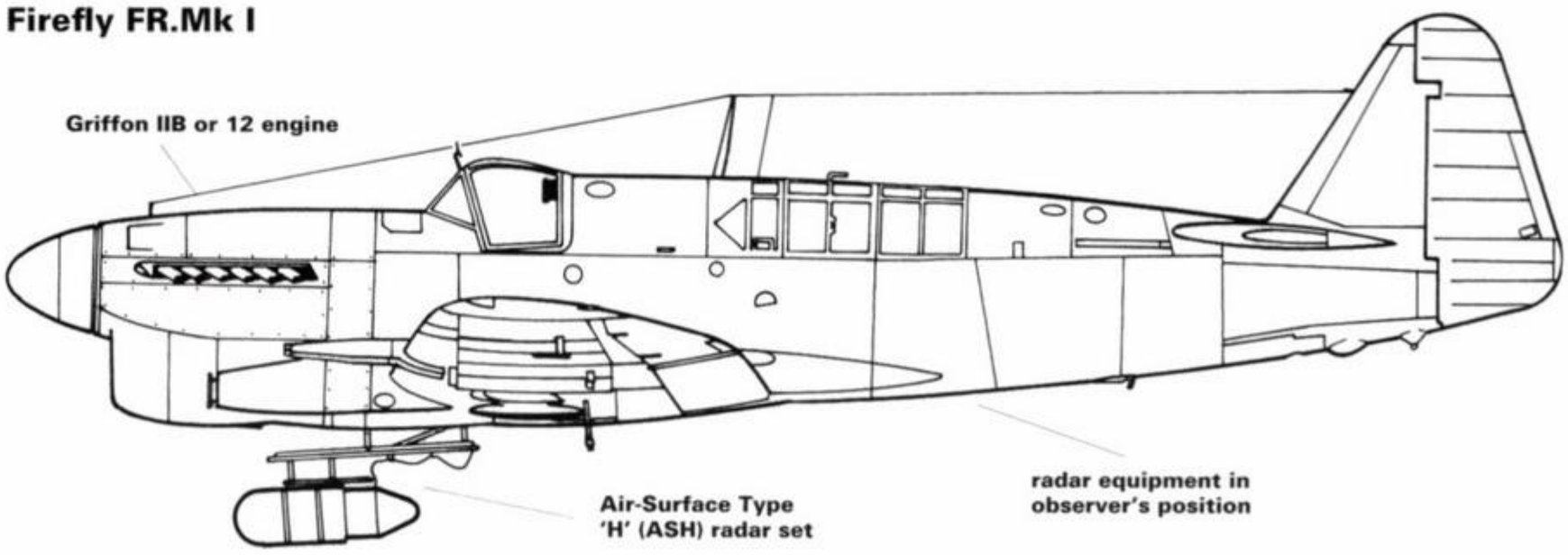
Once the problems plaguing the Air-Surface H (AN/APS-4) radar nacelle, as fitted to the F.Mk IA, were under sufficient control to at least allow aircraft to enter squadron service, the necessary modifications were incorporated on the production line and the aircraft so-treated given a new designation. Apart from the radar set, a gyro gunsight was introduced on the FR.Mk I and fitted above the instrument panel. Armament capability remained unchanged.

Some 500 Mk Is (with the serials MB378-419, 433-449, 460-479, 492-536, 549-593, 613-649, 662-758, PP391-437, 456-497, 523-567, 580-623 and 639-660) appear to have been ordered as FR.Mk Is, though production of the FR.Mk I amounted to just 273 aircraft according to Fairey's figures. A number of these aircraft were undoubtedly completed to NF.Mk I night-fighter standard.

The FR.Mk I was released for service use in February 1945, and squadrons operating the F.Mk I also received FR.Mk Is. This variant went on to become the Fleet Air Arm's standard two-seat fighter of the immediate post-war period.

Though its integration with the Firefly was problem-plagued, the compact AN/APS-4 radar proved more suitable than AI Mk X. This aircraft flies without its pod fitted.

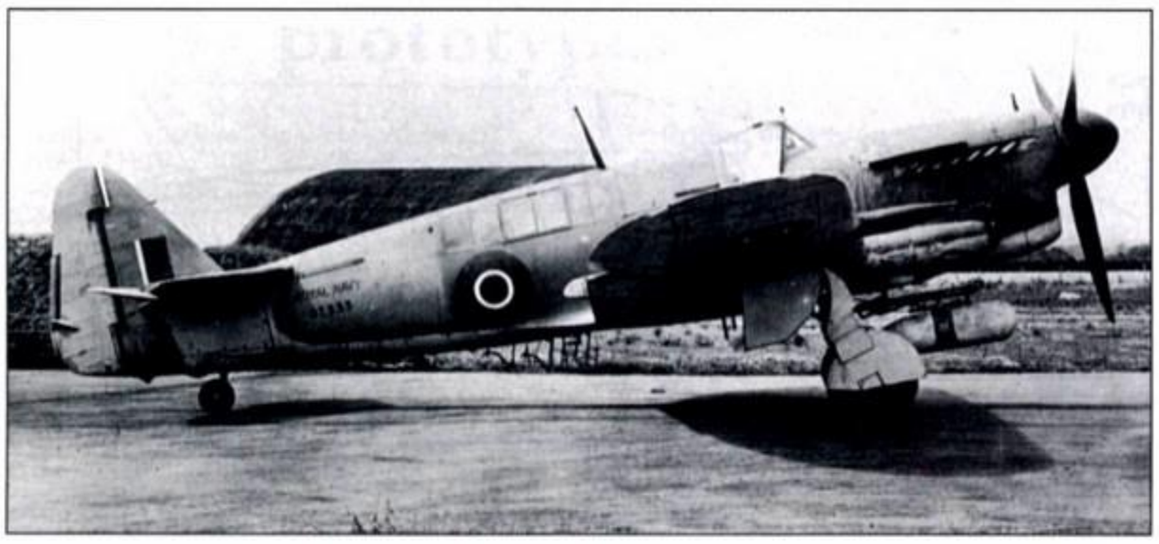
Firefly FR.Mk I



Firefly NF.Mk I

This night-fighter version of the FR.Mk I was developed in response to the failure of the NF.Mk II (which, oddly, predated the Mk I), with relatively straightforward modifications made to FR aircraft on the production line to produce the night-fighter. The aircraft were to be fitted with an anti-glare shield (developed by Rolls-Royce) over the engine exhaust manifolds, though it would appear that this was not always fitted as standard and only introduced for aircraft engaged in prolonged night-time operations. Performance was not impaired. Armament was the same as for other Mk I aircraft.

Mk I DT933 was equipped with radar as an NF prototype. Series production was 140 aircraft, like the FR.Mk Is, drawn from original F.Mk I batches. Nos 1790, 1791 and 1792 were earmarked as night-fighter units to form up and join the growing British Pacific Fleet; No. 1790 received its first aircraft in January 1945. In May 1943, No. 746 Squadron, the Night-Fighter Interception Unit based at Ford, received its first NF.Mk Is to develop naval night-fighter tactics, working alongside the RAF's FIU, also at Ford. Flying from RAF Coltishall during late 1944, NFIU Fireflies undertook night patrols to counter V-1 flying bombs air-launched over the North Sea by He 111s. These sorties confirmed the satisfactory operation of the ASH set in the 'NF' role.



DT933, the first 'production' Firefly NF.Mk I, shows the ASH radar installation under the nose and the anti-glare exhaust shrouds.

This top view of PP425 shows to good effect the anti-glare shield above the rear half of the Griffon's exhausts.

Firefly trainer prototypes

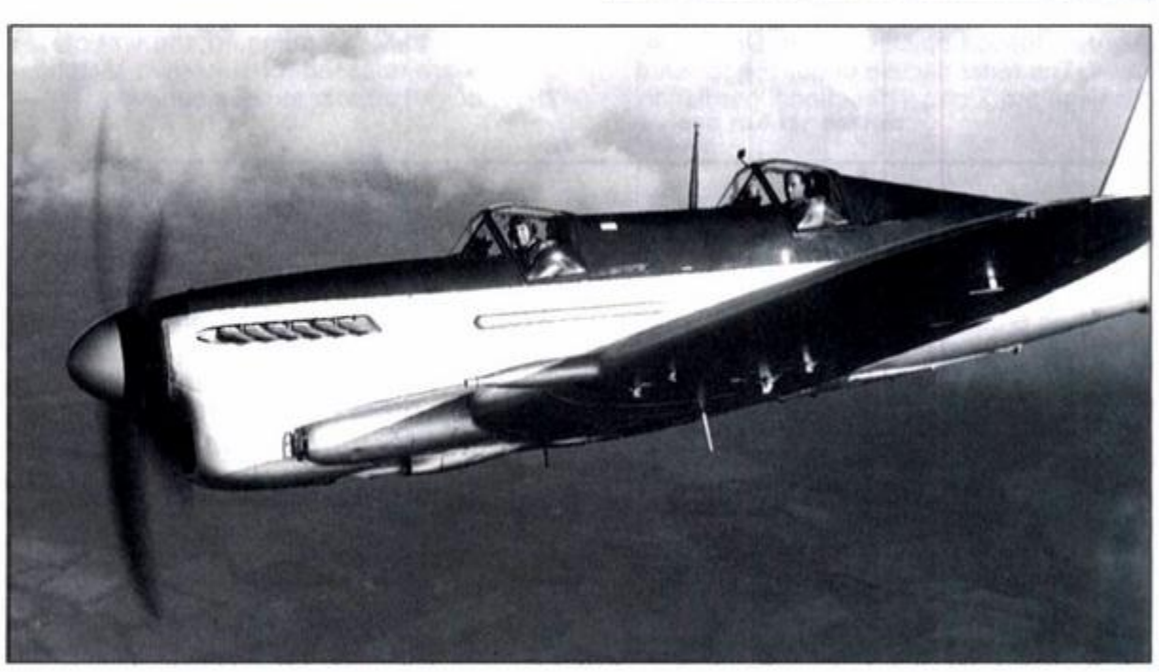
The Firefly trainer began as a private project by the Fairey company when it realised the FAA did not have a high-performance dual-control trainer capable of deck landing. A Firefly FR.Mk I, MB750, in Fairey's factory at Stockport for repair, was set aside with Admiralty approval to act as a prototype.

Interest from foreign air arms was considerable, so upon conversion to trainer standard, the aircraft was registered G-AHYA, to allow its use as a company demonstrator overseas. However, the civil registration was never carried, MB750 being simply marked 'F1'. Later, roundels and the serial number were reapplied.

Admiralty concern about airflow problems around the new fuselage configuration resulted in a requirement that the aircraft be capable of making (and recovering from) four-turn spins. To this end, and to ensure that the original programme was not delayed, a second machine, Z2033, also on the repair line at Stockport, was earmarked as the flying mock-up and spin clearance trainer. This machine, after conversion, received the civil Class-B markings, G-6-3.

In creating this dual-control variant, Fairey's design office came up with a conversion whereby the observer's cockpit was replaced by a single pilot's cockpit unit. In essence, the fuselage just forward of the rear cockpit at Frame 10 was cut away and replaced by a new structure that faired into the rear fuselage. An increase in width at the decking line and a new turtleback and side fairings were inserted. A complete pilot's cockpit was then fitted, but raised some 12 in (30 cm) to give the instructor a clearer view forward. The instructor's cockpit was equipped only with the instruments and controls necessary for his role; for example, no gunsight was fitted. Trials showed that there were no problems with the trainer layout and that the Admiralty's fears were groundless. Thirty-four aircraft were ordered for the FAA, to be known as Firefly T.Mk 1s. The first of the two prototypes, MB750, was later refurbished and converted to T.Mk 2 standard for sale to the Royal Thai Navy as trainer SF9. Z2033 became the layout test airframe for the target-towing Firefly. After refurbishment it was later sold to Sweden as SE-BRD.

Upon conversion to trainer standard, MB750 retained two of its cannon – a feature shared with a handful of T.Mk 1s and all production Firefly T.Mk 2s.

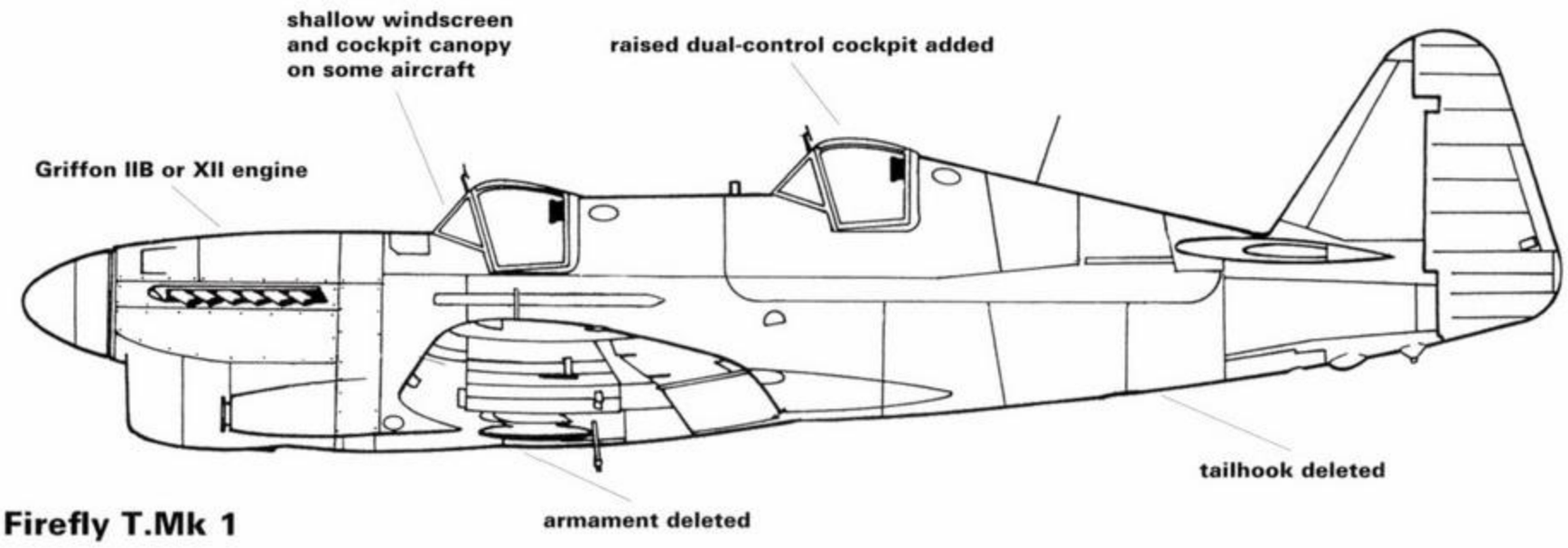


Left: In high-visibility trainer yellow, T.Mk 1 Z2027 banks for Charles Brown's camera. Like the majority of its sisters, this aircraft has had all four cannon removed during conversion.

Firefly T.Mk 1

In this aircraft – essentially a Mk I with operational equipment removed – the observer's cockpit was replaced with an instructor's cockpit and dual control, with the seat raised 12 in (30 cm) to improve his view forward. Eventually 34 were converted, of which at least six (DK429, 449, 453, DT933, MB465 and 496) were fitted with one 20-mm cannon in each wing. The first production T.Mk 1, MB473, was flown for the first time in its new guise on 23 July 1947. Most squadrons had a trainer on strength to allow dual 'check-outs' for new pilots, as well as general flying and weapons training.

Those converted were Z1866, 1873, 1909, 1943, 1953, 1969, 1980, 2015, 2021, 2025, 2027, 2054, 2108, 2111, 2119, DK429, 445, 447, 449, 453, DT933, 974, 975, DV132, 133, MB379, 412, 433, 437, 441, 443, 465, 473 and 496.


shallow windscreen and cockpit canopy on some aircraft
raised dual-control cockpit added
Griffon IIB or XII engine
tailhook deleted
armament deleted

Firefly T.Mk 1

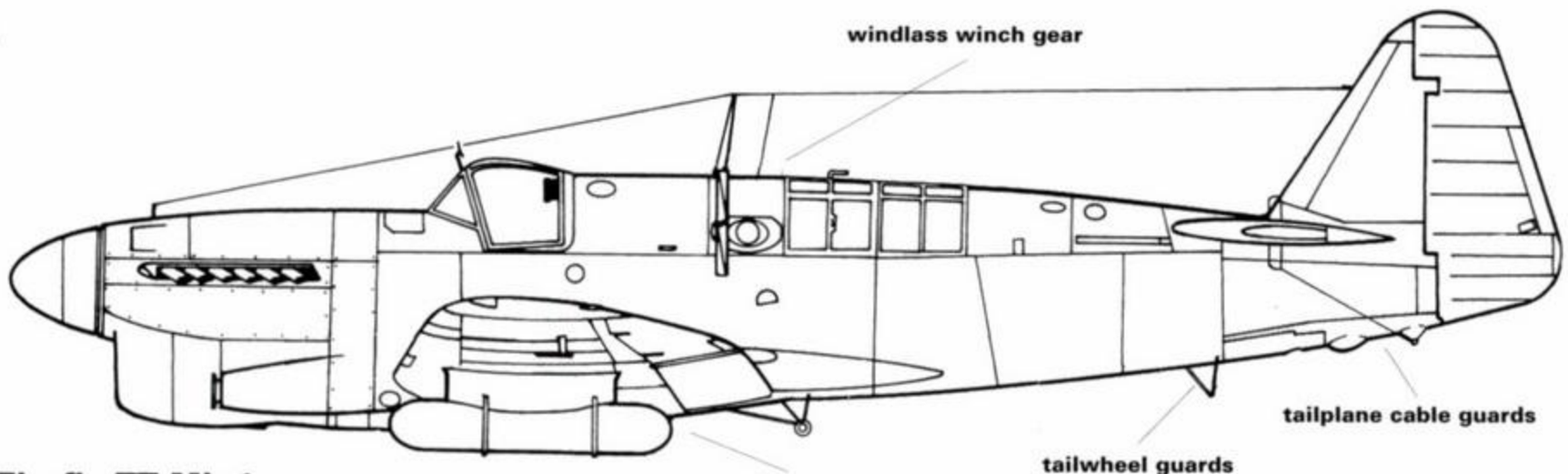
Firefly TT.Mk 1

Although the Royal Navy had not expressed an interest in a target-towing Firefly, there was sufficient interest from foreign air arms and civilian contractors to warrant such a conversion.

On the 'TT' Firefly the rear cockpit was fitted with target-towing equipment and space for an operator. A windlass arm was introduced on the port side of the fuselage just forward of the cockpit. Guards were mounted around the tailplane so that cables could not foul the control surfaces. The trial set-up was tested on F.Mk 1 Z2033 (later employed as the Firefly spin clearance trainer).

The Royal Danish Air Force bought two examples of the TT.Mk 1 (converted from Mk Is Z1842 and Z2020 and given the RDAF serials 625 and 626, respectively), the Indian Navy five (INS111-115, ex-DK566, 477, PP488, DK479 and 552, respectively) and the Swedish civilian operator Svensk Flygtjanst AB 19 – 16 from Fairey and three at a later date from the RDAF for spares recovery (625, 626 and 630, the latter an ex-Royal Canadian Navy Mk I converted to TT.Mk 1 standard in Denmark).

The 16 original Swedish aircraft were registered as civil aircraft, as follows: SE-BRA (ex-DK568), SE-BRB (DK459, SE-BRC (Z1908), SE-BRD (Z2033), SE-BRF (DT986), SE-BRG (DT989), SE-BRH (MB387), SE-BRI (DV121), SE-BRK (MB503), SE-BRL (DT939), SE-BRM (DK430), SE-BYB (MB624), SE-BYC (MB728), SE-BYD (MB702), SE-CAU (PP469) and SE-CAW (PP392).



Firefly TT.Mk 1

The Indian Navy was among the three customers for a target-towing version of the Firefly Mk I, five of which were delivered in mid-1954. The windlass on INS 112 (ex-DK447) is seen here in the horizontal stowed position. The tailplane cable guards are also visible. This machine carries a 90-Imp gal (409-litre) external fuel tank under each wing.

Firefly NF.Mk II

The Admiralty had intended that this variant, which pre-dated the NF.Mk I, be the standard night-fighter for the FAA and originally placed orders for 328 examples.

Construction was as for the day-fighter but included an extra 15 in (38 cm) built into the fuselage behind the engine bay, so that there were 22 U frames overall instead of the usual 21. This compensated for the extra weight of equipment added to the rear cockpit, which otherwise upset the aircraft's centre of gravity. The AI Mk X radar's transmitter and receiver antennas were mounted in two faired nacelles projecting forward from each wing between the cannon and forward fuselage.

These changes exacerbated the aircraft's directional instability and, though improved with detail changes (the C of G was moved forward and the radar nacelles shortened), the problem was not entirely solved. Other changes to suit the night-fighter role included a tandem generator system and a projector unit suspended beneath the instrument panel to replace the gyro gunsight.

The new model was introduced on the Mk I production line, but just 37 aircraft were completed. The first 14 came from early Mk I production, as follows: Z1831, Z1833, Z1836, Z1840, Z1841, Z1845, Z1865, Z1868-1870 and Z1874-1877. The balance of the original order for 100 aircraft was to have comprised Z1894-1898, Z1971-1976, Z2045-2052, Z2055-2060, Z2092-2095, Z2121-2126, DT926-930, 950-961, 992-998, DV112-116, 135-146 and MB450-459.

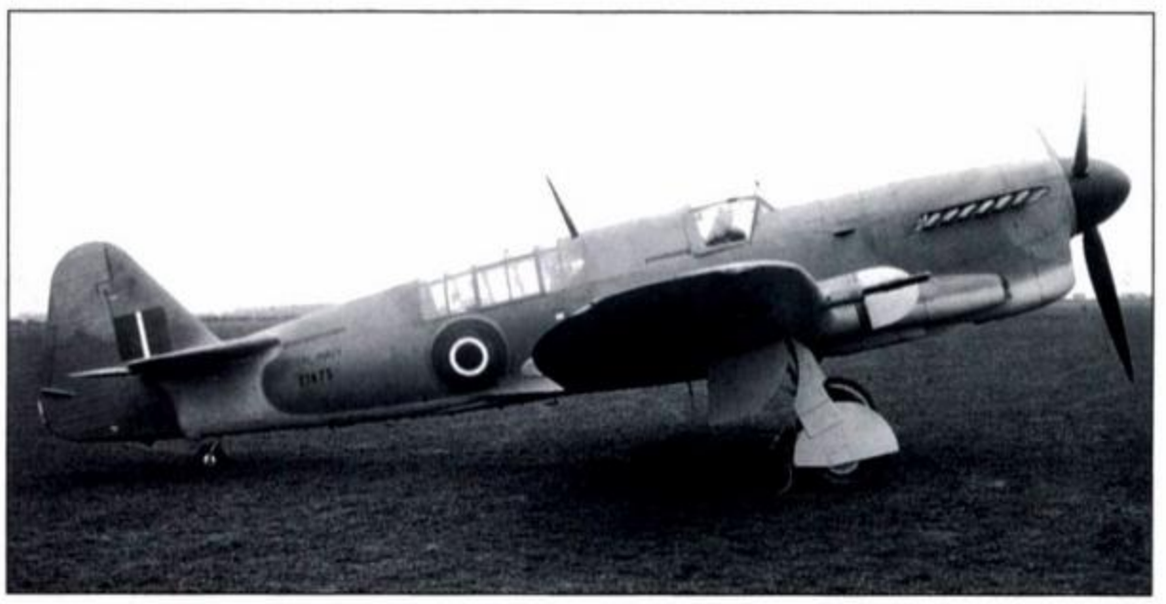
15-in (38-cm) fuselage plug
radar equipment in observer's position
Griffon IIB engine
nacelle for AI Mk X radar transmitter/receiver

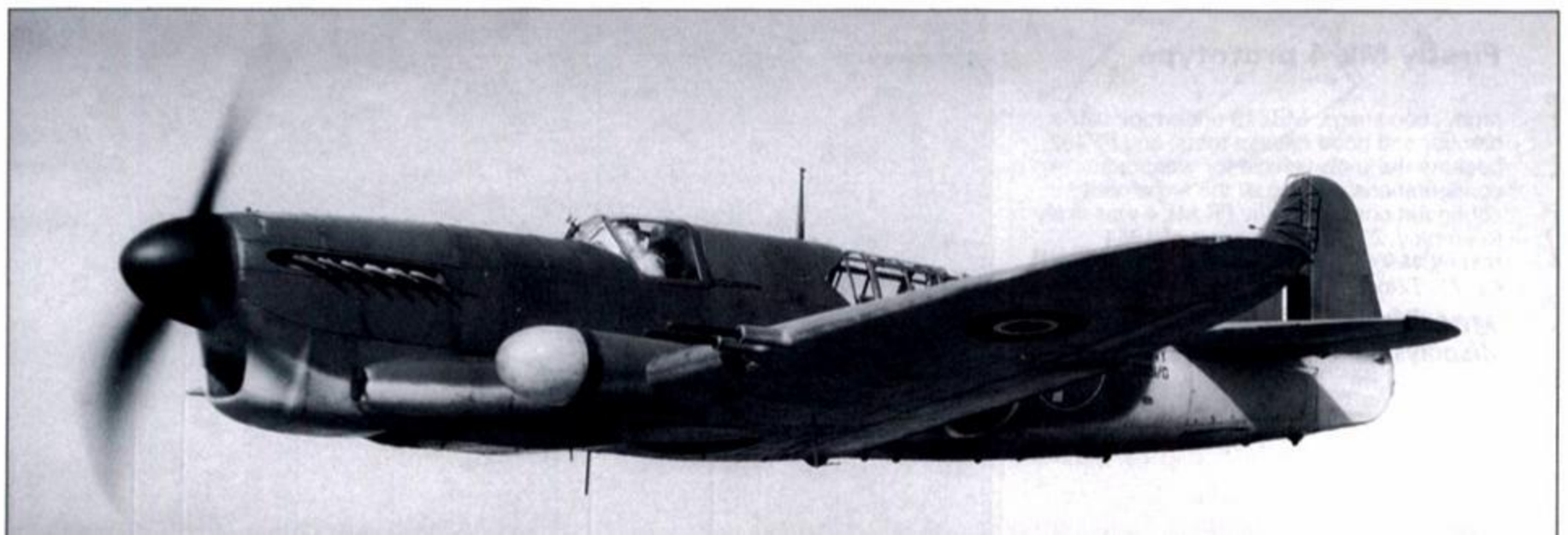
Firefly NF.Mk II

Deck handling problems due to the aircraft's longer nose (culminating in a crash-landing aboard HMS *Ravager* during trials), radar integration snags (caused by the radar nacelles' proximity to the fuselage) and the time-consuming nature of Mk II development mitigated against the aircraft. The majority of the 37 built (of over 300 projected) were later converted to NF.Mk I standard; a few remained until declared surplus and scrapped.

Serial numbers of the remaining 23 aircraft are believed to have included all but one of the following: Z1894-1898, Z1971-1976 and Z2045-2058.

Right: Z1875 has the shorter radar nacelles fitted later in an attempt to solve centre-of-gravity problems.





Left: In this view of the first NF.Mk II, Z1831/'G', the lengthened nose of the Firefly Mk II is clearly evident. Production aircraft would undoubtedly have been equipped with the raised cockpit canopy, as fitted to later production Mk Is; the prototype Mk IIs retained the original canopy design. Note the anti-spin strakes on the fin of the aircraft.

Firefly T.Mk 2

Following the success of the Firefly T.Mk 1 it was decided to convert more airframes but equip them for use as tactical weapons trainers. Each aircraft had one 20-mm cannon in each wing, a gyro gunsight in the front cockpit, and hardpoints under the wings to allow the carriage of various external stores such as 500-lb (227-kg) bombs, mines and smoke floats.

Some 54 were converted at the Fairey Stockport factory, with the first T.Mk 2 making its initial flight on 12 August 1949.

As with the T.Mk 1, many units had examples on strength but it was the operational training squadrons (including those in the RNVR) that made most use of the type.

IEAF Firefly T.Mk 2 603 started life as Mk I MB382. Here it is seen alongside two of the eight refurbished ex-FAA F.Mk Is delivered concurrently.

Firefly F.Mk III

The 1,540-hp (1148-kW) Griffon 61, with two-stage supercharging for improved performance at altitude, was introduced to the Firefly in the proposed Mk III. Rolls-Royce suggested that the extra weight of this engine and its cooling system could be compensated for by replacing the 'beard' radiator with leading-edge radiators, as fitted to the Mosquito. Fairey was happy with this solution, but an Admiralty demand that the Griffon 61 be introduced into the Firefly production line by the beginning of 1944 made such an extensive redesign impossible within such a short space of time. Thus, the Mk III prototype (Z1835) was equipped with an enlarged 'beard' radiator as originally envisaged. Tested from May 1943, it handled unsatisfactorily in the air and was eventually pronounced totally unsuitable for service use. Among the problems identified were poor directional control, longitudinal instability with flaps and gear down, high drag from the powerplant installation and excessive heat and fumes from the engine. The aircraft's top speed was also slower than expected.

Such was the extent of the aircraft's shortcomings that it was abandoned in late 1944, in favour of the Mk IV, with Rolls-Royce's leading-edge radiators.

Z1835 eventually became the second prototype Mk 4, powered by the Griffon 72, a Griffon 61 variant modified for naval use, and a forerunner of the Griffon 74, the production engine used in all the Firefly Mk 4/5/6 family.

Fifty Mk IIIs, to be serialled TK517-538 and 550-577, were ordered from the sub-contractor General Aircraft Limited, but all were subsequently cancelled.

Left: The prominent 'beard' radiator, fitted to the Mk III prototype Z1835 to cool the two-stage Griffon 61 engine, may be seen in this view.

Right: The experimental exhaust baffles fitted to the sole Mk III aircraft are visible in this photograph. Note also the unfaired cannon and shallow windscreen and cockpit canopy.

Firefly T.Mk 3

Around 50 FR.Mk Is were converted to T.Mk 3 standard during the period 1949-51 by RN maintenance units; PP411 was the first, all subsequent conversions falling in the PPxxx serial range. Changes included the addition of training aids, such as drift recorders, to the rear cockpit. Otherwise, there was initially no external difference between an FR.Mk 1 and a T.Mk 3, as the radar was retained. However, after some training experience the ASH nacelle was removed.

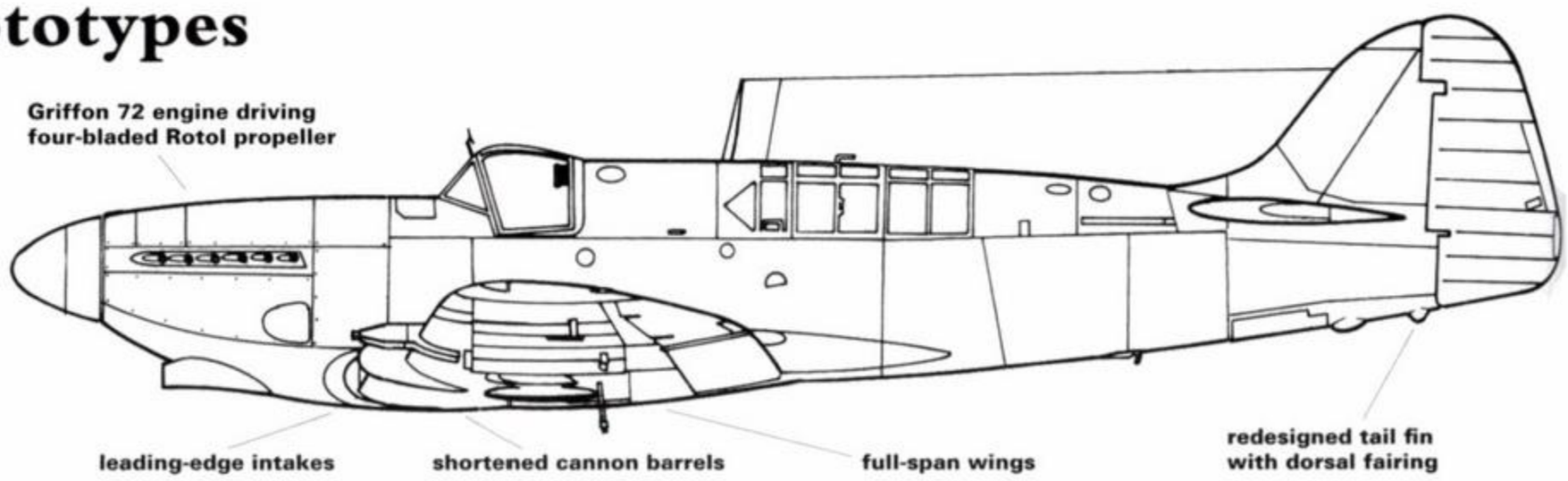
T.Mk 3s were limited by their inability to accommodate more than one trainee observer at a time. By 1953 the variant was beginning to be replaced in the training role by the Firefly T.Mk 7.

Firefly T.Mk 3 PP523 served with No. 796 Squadron during 1952/53 and is seen here while still fitted with an ASH radar nacelle. Externally the T.Mk 3 was indistinguishable from an NF.Mk I; interestingly, this aircraft has an exhaust shroud fitted, of the type normally seen on NF.Mk Is.

Firefly Mk 4 prototypes

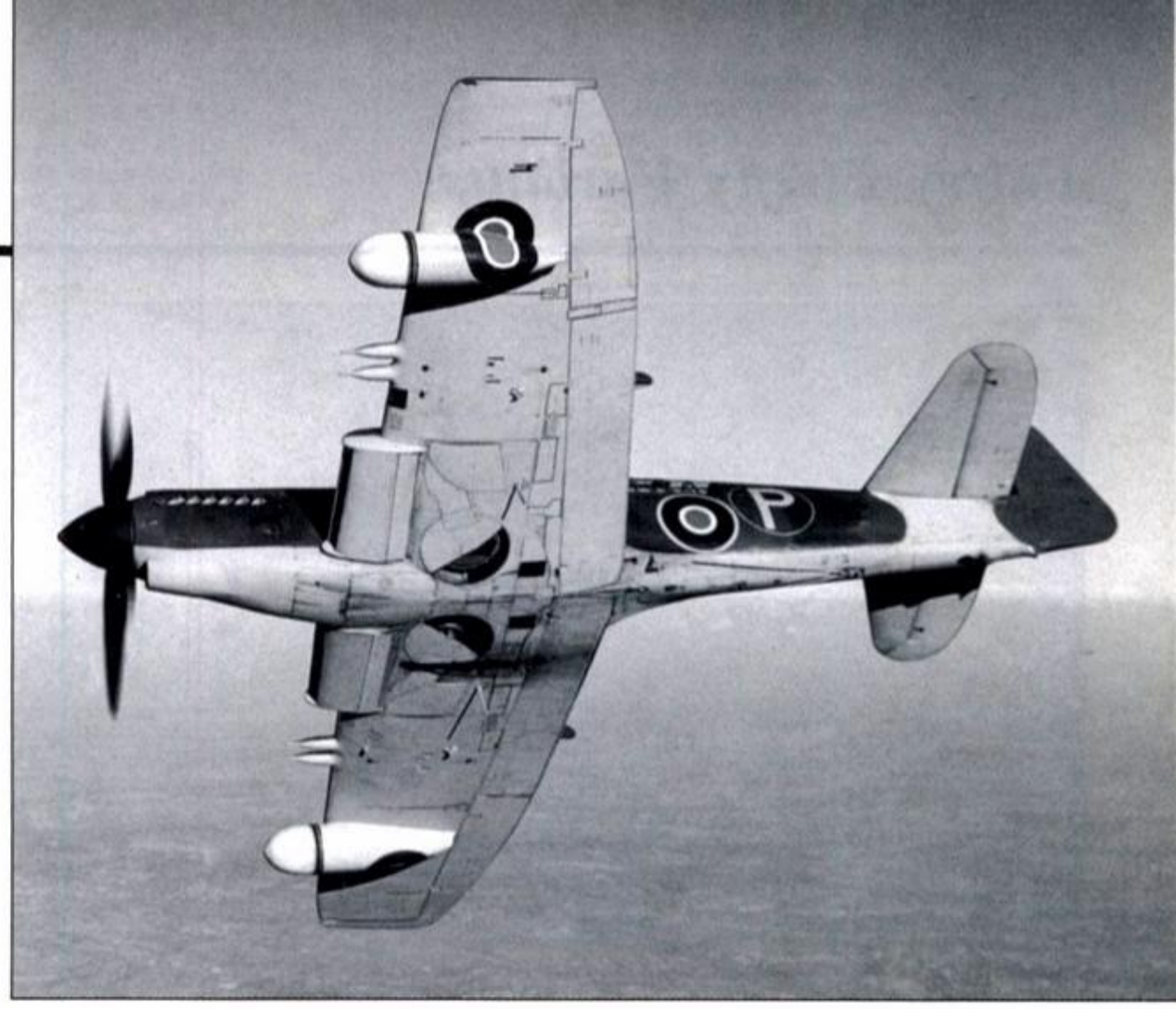
The introduction of the Firefly Mk 4 saw a change in design whereby the coolant and oil radiators were removed from beneath the engine bay and put in the leading edge of the centre-section. Square wingtips replaced the elliptical ones, and a dorsal fairing was faired into the tailfin and rudder. The planned engine was the Griffon 74 but, in the interim, the Griffon 72 was fitted to the prototypes. On production aircraft the ASH nacelle, previously fitted under the nose, was to be contained in an egg-shaped structure mounted on the starboard wing. To counter-balance the new nacelle, a similarly-shaped fuel tank was mounted on the port wing using modified bomb carrier pick-up points.

Two prototypes were initially ordered, Z1835 and Z2118, but when the programme began to slip two further machines, MB649 and PP482, were allocated to hasten progress. The first interim prototype Firefly FR.Mk 4, Z2118, flew for the first time on 25 May 1945 at the GWA. After preliminary trials Z2118 went to Boscombe Down on 27 July 1945 for flight handling trials. The Mk 4 gaining good test reports, and by October two prototypes were flying at Heston and the two additional conversions were almost complete. Z2118 was used to iron out production snags, MB649 undertook flame damper and hood release tests, and PP482 became the trials vehicle for weapons configurations, testing all the armament configurations the Firefly FR.Mk 4 was likely to employ. Z1835 spent most of 1944 testing various Griffon engine variants – the 61, 71, 72 and finally the 74.


Griffon 72 engine driving four-bladed Rotol propeller
leading-edge intakes
shortened cannon barrels
full-span wings
redesigned tail fin with dorsal fairing

Firefly Mk 4 prototype

MB649, the third Mk 4 prototype, displays its 'clipped' wings.



Above: By the time that this photograph was taken, Z2118 was equipped with underwing pods for radar (starboard) and fuel (port). Note the unusually applied underwing roundel 'wrapped around' each pod. The arrangement of the Mk 4's leading-edge radiators is also clear. Among the other changes introduced as a result of flight testing were short-barrelled Hispano Mk V cannon, a longer propeller spinner and a high-gloss paint scheme.

Above left: Z2118, originally intended as the second Mk III but completed as the first of the Firefly Mk 4 prototypes, first appeared with a Mk I tailfin, elliptical wings and a long undernose carburettor air scoop.

Left: Third Firefly Mk 4 prototype MB649 was reconfigured as the first NF.Mk 4 prototype and was experimentally fitted with this unusual exhaust baffle aimed at suppressing the glare of the aircraft's exhausts.

Firefly FR.Mk 4

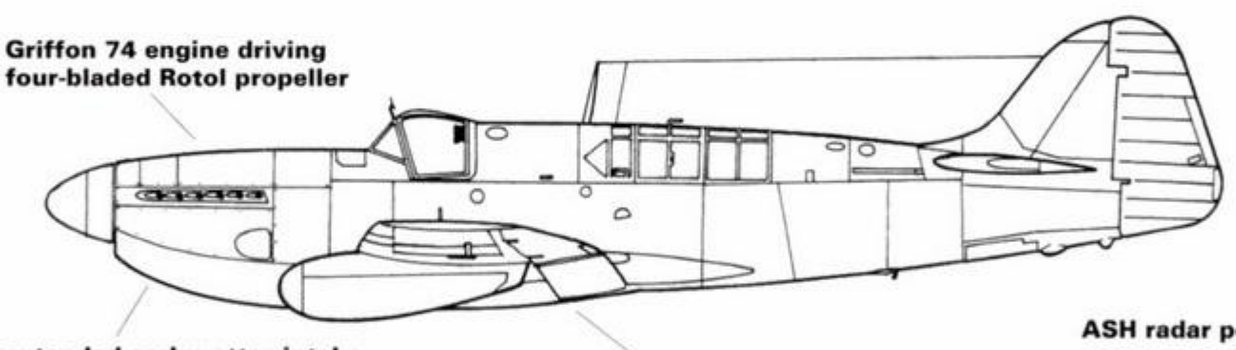
The change in design layout introduced in the Mk 4, with its two-stage Griffon 74, was accompanied by other improvements, including a Rotol four-bladed propeller, 'clipped' wingtips and a dorsal fin added to the reprofiled fin and rudder. The ASH nacelle was redesigned and moved from under the nose to the starboard wing. It was balanced on the port wing by a 55-Imp gal (250-litre) fuel tank. An IFF (Identification Friend or Foe) aerial assembly was fitted to both sides of the fin to warn of aircraft approaching from behind.

The first 43 FR.Mk 4s – TW687-699 and TW715-721 – were converted on the Mk 1 production line. A further 77 were built as true Mk 4s – TW722-754, VG957-999, VH121-144. The balance of the original Mk 4 order (133 Mk 4s to be serialled VH145-148, 163-191, 203-245, 270-305 and 341-361) was cancelled.

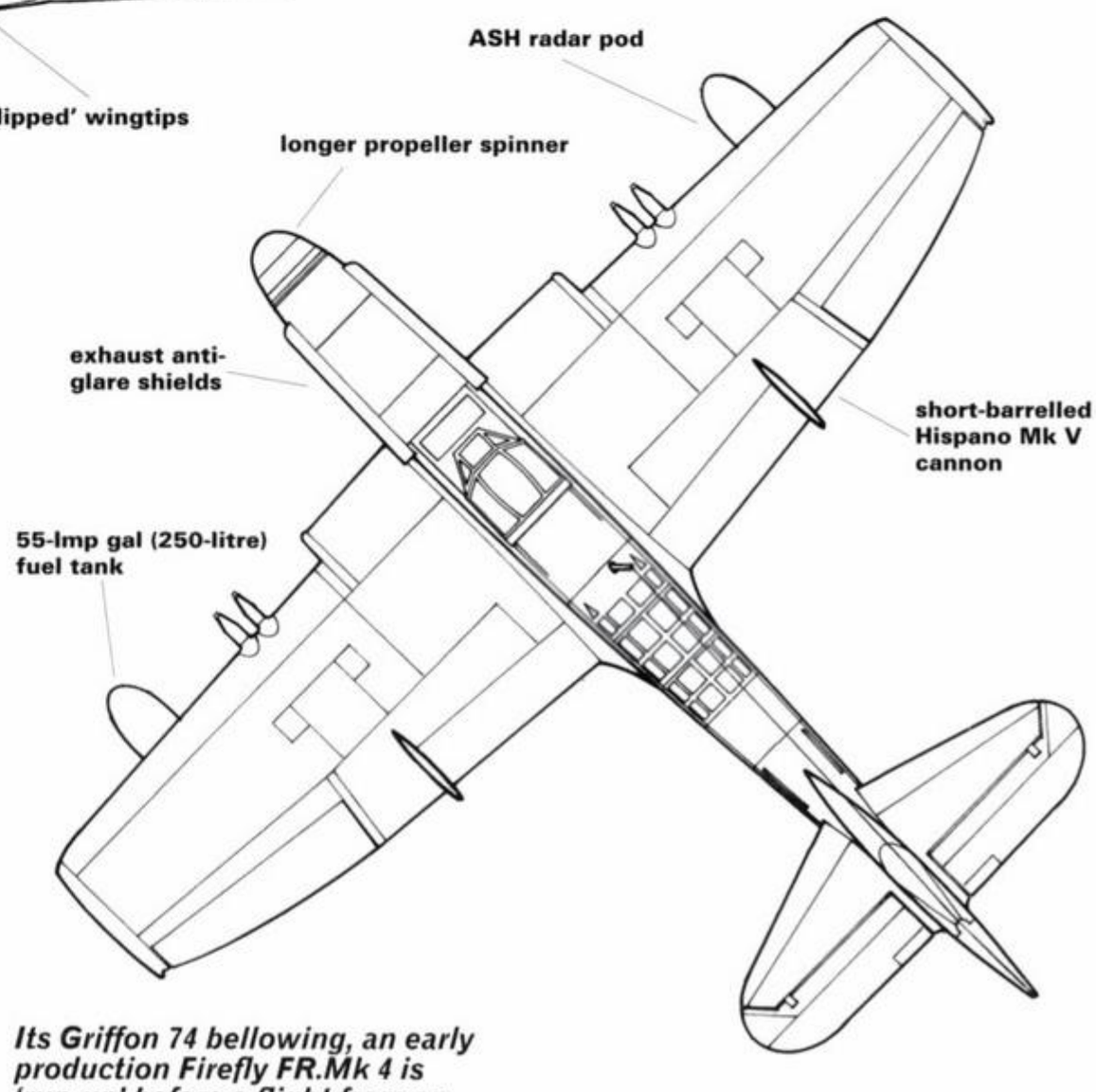
Orders placed with General Aircraft Limited for 115 FR.Mk 4s with serial numbers TW121-168, 190-216 and VF439-478 were also subsequently cancelled.

Though a total of 123 NF.Mk 4 night-fighters was also ordered (the second batch of 100 with the serials VH203-245, 270-305 and 341-361), most were cancelled. (In fact, Fairey records show that all Mk 4s were delivered as FR.Mk 4s.) Though there was little internal difference between the FR and NF.Mk 4, the use of Mk 4s in the latter role appears to have been limited.

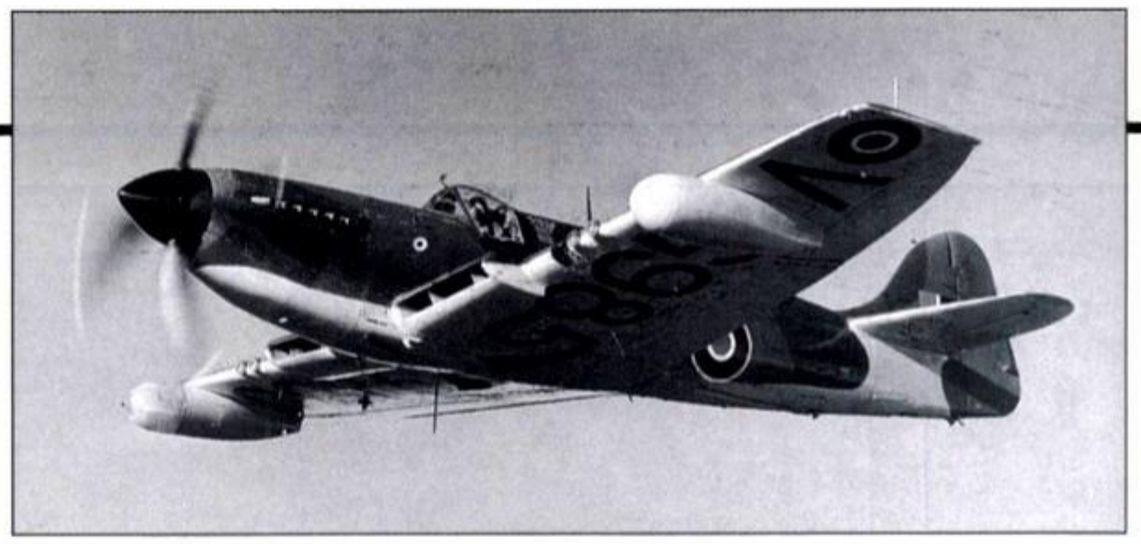
The Royal Netherlands Navy bought 40 new FR.Mk 4s before production ceased, these being initially serialled K-31 to K-70. The Firefly FR.Mk 4 entered service with No. 825 Squadron, FAA in August 1947, followed by Nos 810, 812, 814 and 1840 Squadrons, but was quickly superseded by the Firefly Mk 5. An order for FR.Mk 4s for the Royal Canadian Navy was converted to FR.Mk 5s before delivery.



Firefly FR.Mk 4



Its Griffon 74 bellowing, an early production Firefly FR.Mk 4 is 'run-up' before a flight from an unidentified Royal Navy carrier.



Above: VG985 is a 'true' Mk 4, i.e., a Firefly that was built as such. The first 43 Mk 4s were, in fact, aircraft that started life as Mk Is, but were converted before completion to Mk 4 standard.

Left: Two early production Mk 4s exhibit the high-gloss camouflage scheme introduced on the early aircraft. The FR.Mk 4 was released to the Service, for operation from shore bases only, in February 1947; by August the first examples had reached No. 825 Squadron as part of the 19th CAG, Royal Canadian Navy. The first FAA unit to receive the type was No. 810 Squadron in October.

Firefly Mk 4 contra-prop trials aircraft

In June 1945 the Ministry of Supply, having taken over aircraft production from the wartime MAP, asked Fairey to consider the problems of installing contra-rotating propellers in a Firefly for possible production aircraft. As the main role of the Mk 4 was to be night-fighting, the Ministry was looking at ways of eliminating swing on take-off, as well as to attempt to reduce the effects of torque when aircraft had to 'open up' quickly on approach to, or 'go round' from, a carrier's flight deck.

Fairey took TW695 off the production line and on 25 November 1946 it was delivered to the Rolls-Royce test airfield at Hucknall in Nottinghamshire. It was initially flown as delivered, with a standard Griffon 74 driving a Rotol four-bladed 13-ft (3.96-m) diameter propeller, to provide data for a standard production aircraft for comparative purposes. It then went through a series of engine/propeller changes, which included the installation of a six-bladed contra-rotating propeller. Over the ensuing months, the aircraft went back and forth to Fairey at Heston, White Waltham and Hucknall, demonstrated by Fairey test pilot Peter Twiss. It appeared at the first post-war SBAC Display at Radlett in October 1947.

Flight tests did not yield sufficiently improved results, so TW695 reverted to standard FR.Mk 4 configuration and was delivered to the FAA in 1953.

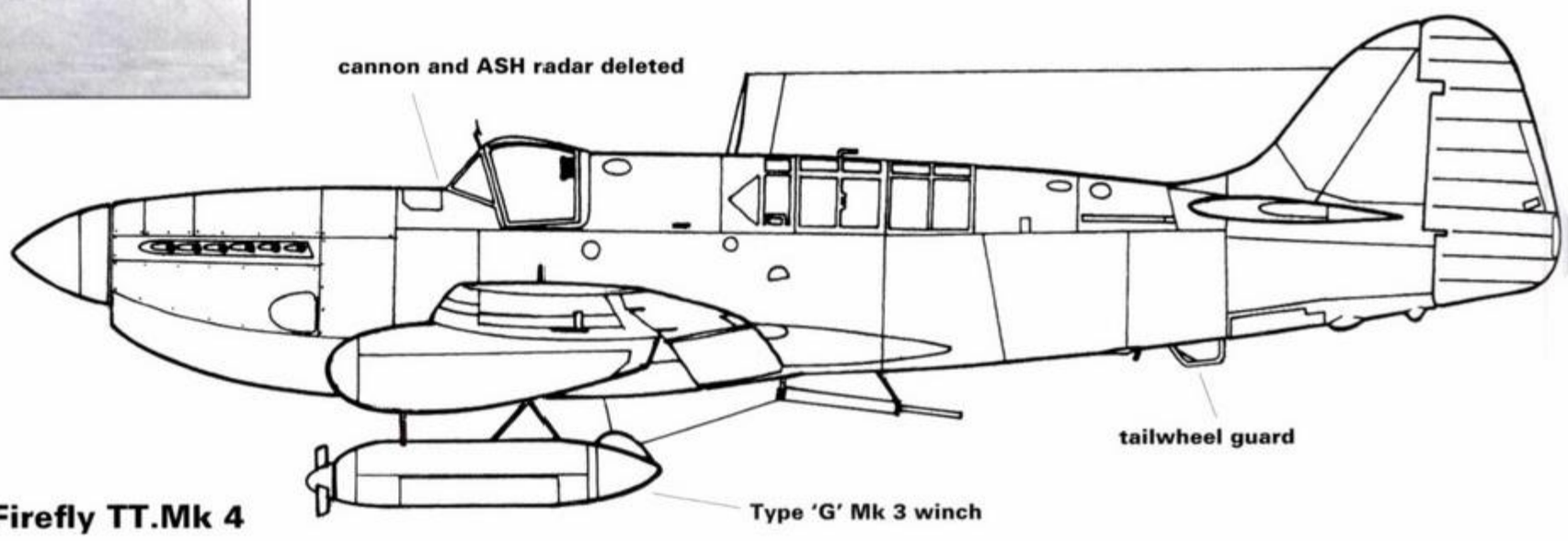
Although it solved the Firefly's torque problems, the contra-prop failed to reach production aircraft.

Firefly TT.Mk 4

A Fleet requirement for a target-towing aircraft led Fairey to offer the Admiralty converted Firefly Mk 4s. A nacelle fitted under the fuselage contained a fully-feathering Type 'G' Mk 3 winch in place of the windlass-type tug winch as fitted to earlier Firefly tugs. Some 28 airframes were converted: VG957, 958, 961, 962, 965-968, 974, 977, 979, 982, 988, 993, VH126, 127, 132, 143, TW722, 723, 733, 734, 737, 739, 744, 750, 751, 753. The two principal users were Nos 700 and 771 Squadrons.

TW722 was a Ford-based No. 771 Squadron TT.Mk 4. In an emergency, the winch cable could be severed and/or the entire winch jettisoned, by either the pilot or winch operator.

VH132 was a TT.Mk 4 of No. 771 Squadron (the Southern Fleet Requirements Unit) based at Ford from 1952. Finished in all-over aluminium with yellow bands, this aircraft was probably photographed towards the end of the period. No. 771 Squadron aircraft carried three-figure codes in the '5xx' series. Note the winch propeller, which was able to be fully feathered when not in use. The FAA operated Mk 4 tugs until 1957, when the fleet requirements role was taken over by Airwork.



Firefly TT.Mk 4

Firefly FR.Mk 5
No. 821 Squadron
14th CAG
HMS *Glory*
March 1953

'Clipped' wings
The 'universal' airframe of the Firefly Mks 4, 5 and 6 introduced wing-mounted radiators with leading-edge intakes. 'Clipped' wings compensated for the resultant increase in wing area; these also afforded an improved rate of roll. On the starboard wing an ASH radar set was housed in a flush-fitting pod, balanced on the port wing by a 46-Imp gal (209-litre) fuel tank. If necessary, the radar pod could be replaced with a second tank on all three marks. During Mk 5 production, a hydraulic wing-folding mechanism was introduced for the first time in the Firefly and was retrofitted to early-build Mk 5s.

Lieutenant J. F. K. 'Sean' McGrail, No. 821 Sqn, Fleet Air Arm carried out many of his 118 operational sorties against Korean targets (between 12 November 1952 and May 1953) in VT488 205/'R' from the deck of HMS *Glory*.

Weapons
For operations over Korea, Firefly FR.Mk 5s were armed with a variety of air-to-ground weapons. Typical loads included two 500-lb (227-kg) or 1,000-lb (454-kg) bombs, four 60-lb (27-kg) rockets, depth charges or (towards the end of the 'police action') leaflet bombs.

14th Carrier Air Group
No. 821 Sqn joined the 14th CAG in HMS *Glory* (with No. 801 Sqn's Sea Furies) as it began its third stint in the Korean theatre on 1 November 1952, replacing No. 812 Sqn. Within its first week of operations, the unit had undertaken TARCAPs (Target Combat Air Patrols), bombed a bridge near Changyou, attacked troop positions in support of UN forces and rocketed a gun emplacement on the west coast. Over 11 patrols during the following six months, No. 821 flew 1,721 sorties.

No. 821 Squadron, FAA
No. 821 had been equipped with eight Firefly AS.Mk 6s since its reformation as an anti-submarine unit in September 1951. For service off Korea, however, it was given a strike role the following May, exchanging its Mk 6s for 10 (later 12) FR.Mk 5s. In September, the unit began working up aboard *Glory*, reaching Korean waters in November.

Nose art
Lt McGrail's scantily clad personal marking was applied on a removable panel on the port side of the aircraft, behind the engine. This allowed it to be easily moved to another aircraft if necessary. Nose art was rare among FAA Fireflies during Korean deployments.

Colours and markings
VT488 wears the standard FAA colour scheme introduced in 1948 – Extra Dark Sea Grey upper surfaces and Sky below. At this time Type 'D' roundels were introduced and the fin flash dropped. As the FAA's aircraft were unfamiliar to US servicemen, two black and three white 12-in (30-cm) alternating stripes were applied to fuselages and wings.

Firefly FR/AS/NF.Mk 5

The Firefly Mk 5, with its 'universal' airframe, was able to perform the fighter-reconnaissance, anti-submarine and night-fighter roles with minimal changes to equipment in the pilot's and observer's cockpits (though the reconfiguration to night-fighter standard took hours rather than minutes). During Mk 5 production, a powered wing-fold mechanism was introduced, and was retrofitted to early production aircraft.

Anti-submarine tasks were new to the Firefly, equipment for the role including up to 12 American non-directional sonobuoys and two 250-lb (113-kg) depth charges.

Production ran to 338 aircraft with serials VT362-381, 392-441, 458-504, VX371-396, 413-438, WB243-272, 281-316, 330-382 and 391-440, though the last 16 were converted to AS.Mk 6 standard on the production line. In addition, the Royal Netherlands Navy bought 14 new NF.Mk 5s, serialled K-71 to K-84.

By 1948 the Mk 5 had been phased into production in place of the Mk 4. No. 814 Squadron, FAA was the first to re-equip. Other first-line squadrons to operate Mk 5s were Nos 804, 810, 812, 820, 821 and 825 Squadrons plus Nos 816, 817 and 880 Squadrons of the RAN.

When the North Koreans swept over the 38th Parallel into South Korea on 25 June 1950, the later mark Firefly saw combat for the first time. A British and an American fleet were combined as Task Force 77 under Rear Admiral Hoskins, USN and went to war on 3 July. Firefly FR.Mk Is of No. 827 Squadron based on HMS *Triumph* were used initially, but in early October they were replaced by HMS *Theseus* with the 17 Carrier Air Group (CAG) aboard with No. 810's 12 Firefly Mk 5s. Over the next three years the Firefly FR.Mk 5 proved itself to be a versatile strike aircraft, often being flown as a single-seat dive-bomber. Its heyday was the Korean War period; from 1954 it was gradually phased out as the Firefly AS.Mk 6 took over the anti-submarine role.

Above: Power-operated wing-folding (Modification 809) was introduced on the Firefly Mk 5 after thorough testing on VT393 in late 1948. The first production aircraft so-equipped was VX414; earlier aircraft were retrofitted.

Above: The weight of a pair of 1,000-lb (454-kg) bombs approached the Mk 5's load limit.

Above left: In the anti-submarine warfare role, sonobuoys (in this case eight American type) and depth charges (two 250-lb/114-kg examples) could be carried.

Left: Up to eight 3-in (7.62-cm) rockets (in this case with 60-lb/27-kg heads) could be accommodated under the wing of a Mk 5.

Above: VT362 was the first production Firefly Mk 5, flown for the first time on 12 December 1947 and seen here during carrier trials.

Above: RATO trials were conducted with VT393 at RAE Farnborough in 1950. Here the aircraft accelerates down the runway, its rockets ablaze. RATO was used in service, especially when a carrier's catapult was not functional. '393 went on to become the first Mk 5 fitted with powered wing-folding and later served with No. 737 Squadron, FAA.

Left: Streamlined sonobuoy canisters were trialled aboard VT424, seen here with cannon removed. The Mk 5 was limited to the use of British sonobuoys; Mk 6s were able to carry American directional examples.

Firefly T.Mk 5

Recognising the need for a pilot trainer for aircrew new to the Firefly, the Royal Australian Navy contracted Fairey's Australian subsidiary, Fairey Aviation Company of Australia Pty, to convert four Mk 5s to T.Mk 5 standard. They were to be VT440, VT502, VX373 and VX375.

Three kits of the type used to convert Mk I aircraft to trainer standard were supplied from the UK, but required extensive local modification to suit the Mk 5. It appears that, in the event, just two aircraft, VT440 and VX373, were converted.

Some sources refer to VX373, while with No. 723 Squadron, RAN as a 'Firefly Mk 5 T.2' for reasons which are not clear.

T.Mk 5 VX373 was based at NAS Nowra for use as a pilot trainer. Note the fairing covering the dual control lines from the rear cockpit, as seen on T.Mk 1s and T.Mk 2s.

Firefly TT.Mk 5

Using drawings supplied by Fairey, two Royal Australian Navy Mk 5s (WB271 and VX388) were converted as target-tugs, with winch equipment of the type fitted to the FAA's TT.Mk 4s and high-visibility markings.

Right: WB271's engine is run up before its first flight after conversion. Its winch has yet to be fitted, but the cable guides and protective guards are in place. After retirement in the 1960s, WB271 returned to the UK and now is operated by the FAA's Historic Flight.

Left: Like the TT.Mk 4, the TT.Mk 5 was equipped with a fully-feathering Type 'G' Mk 3 winch. Also visible are the winch cable guides under the fuselage and the protective guards in front of the tail wheel to prevent fouling.

Firefly AS.Mk 6

As the Firefly became primarily an anti-submarine aircraft, the Mk 6 was a logical follow-on from Mks 4 and 5. The basic airframe layout remained the same, but internal electrical equipment was modified for use with a wide range of anti-submarine detection gear, including British directional sonobuoys. Although wing cannon were deleted, wing attachment points allowed a wide range of external weapons and long-range fuel tanks to be carried.

Production amounted to 133 aircraft, WB505-510, 516-523, WD824-872, 878-923, WH627-632 and WJ104-121. The last two aircraft, WD924 and WD925, were cancelled and replaced by the two Mk 7 prototypes.

The first Mk 6s were issued to FAA squadrons in 1951, initially No. 814 Squadron, followed by Nos 812, 817, 820, 825 and 826. The RN Volunteer Reserve units. Nos 1830, 1840, 1841, 1842, 1843 and 1844 Squadrons were also equipped with the variant until the demise of the RNVR in March 1957.

The AS.Mk 6 remained the FAA's main anti-submarine type until replaced by Gannets in the mid-1950s.

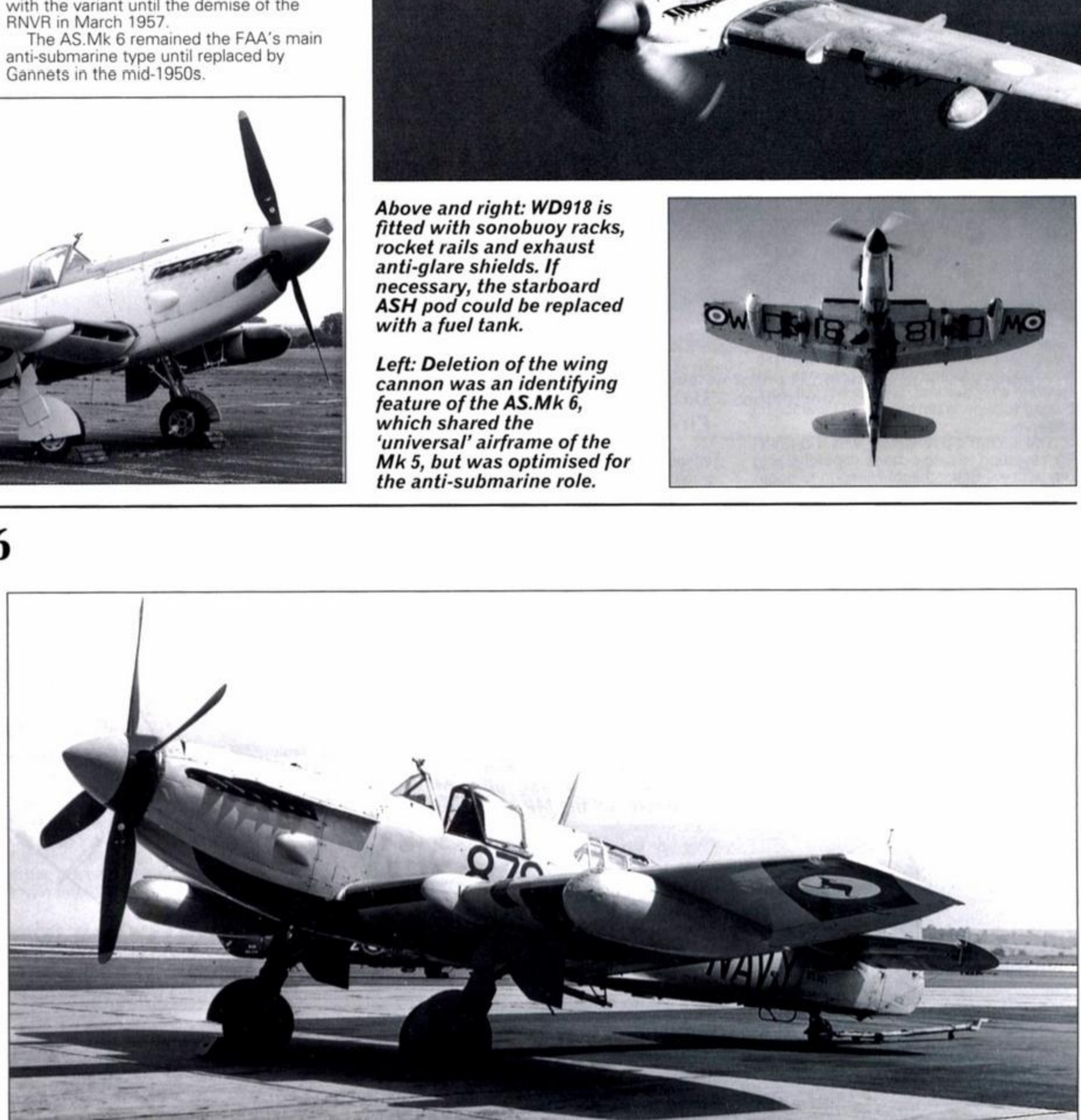
Above and right: WD918 is fitted with sonobuoy racks, rocket rails and exhaust anti-glare shields. If necessary, the starboard ASH pod could be replaced with a fuel tank.

Left: Deletion of the wing cannon was an identifying feature of the AS.Mk 6, which shared the 'universal' airframe of the Mk 5, but was optimised for the anti-submarine role.

Firefly TT.Mk 6

Four conversions were made by the RAN from standard Firefly AS.Mk 6 aircraft, comprising WB518, WD828, WD840 and WD901. As with the Mk 5 conversions, this was done using drawings supplied by Fairey in the UK. The aircraft were finished in silver on the upper surfaces with black and yellow striped undersurfaces.

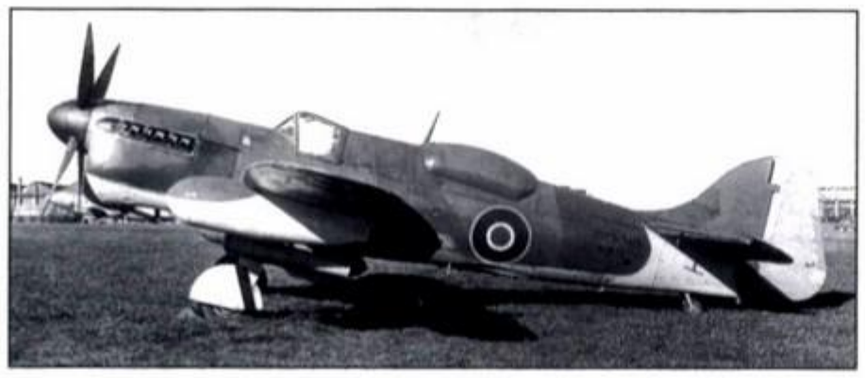
WD901 was among the four RAN TT.Mk 6 conversions and is seen here without its winch fitted. After the Australian government put its remaining Fireflies up for sale in 1966, this aircraft was purchased by a NSW auto wrecker and displayed. The following year it was shipped to the United States and in 1971 joined the Canadian Warplane Heritage collection. Sadly, after restoration to flying condition, '901 crashed fatally into Lake Ontario in 1977.



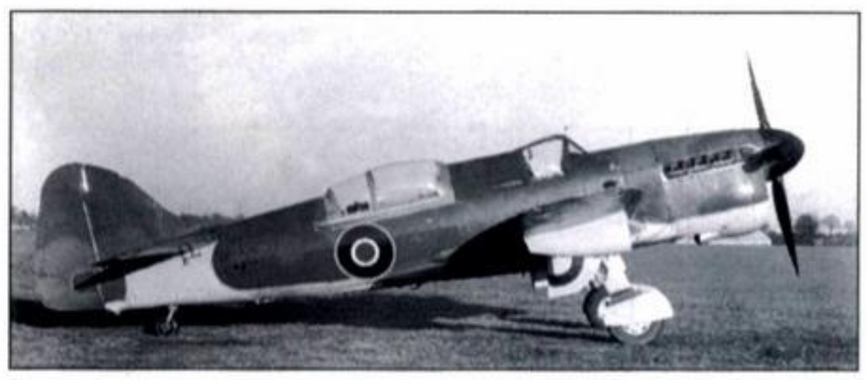
Firefly Mk 7 mock-up and prototypes

On 18 June 1949 Naval Staff Requirements outlined a requirement for an interim anti-submarine aircraft to be used until the Fairey Gannet became available. As the aircraft was expected to have to operate from small British fleet aircraft-carriers around the world, a three-seat version of the Mk 5 was proposed.

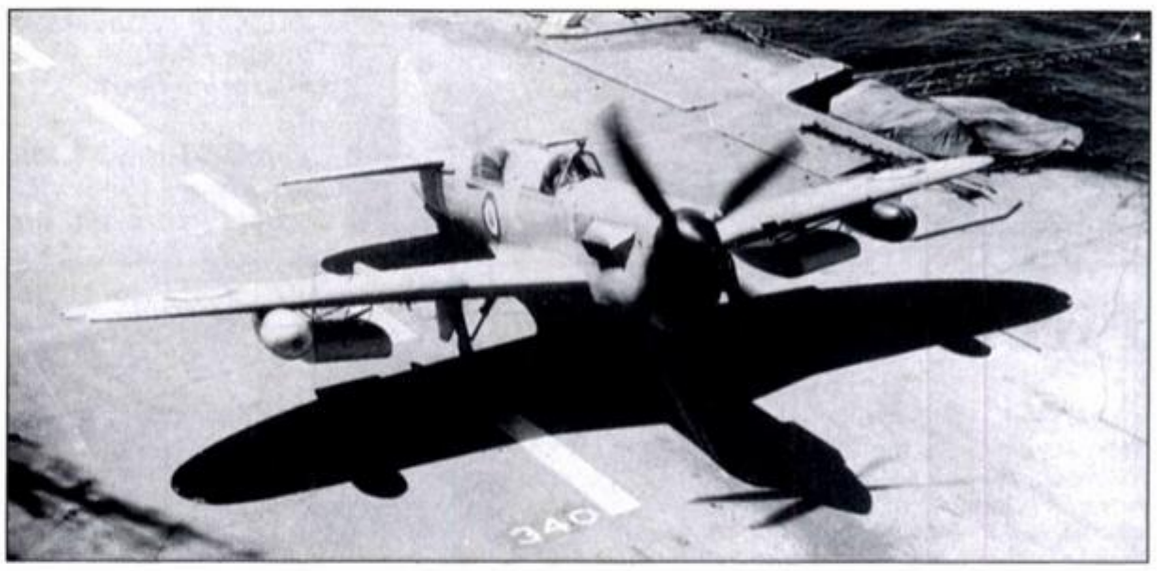
A Firefly Mk 5 airframe would be married to a Barracuda Mk 5 powerplant but with the radiator moved back to a position under the engine, as in the unsuccessful Firefly Mk III. A 2-in (5-cm) extension to the length of the undercarriage legs allowed a 12-ft/min (3.65-m/min) descent rate to the flight deck at a higher weight of 14,000 lb (6350 kg) instead of the 12,300 lb (5579 kg) weight limit imposed hitherto. A Firefly FR.Mk I, MB757, was allotted to the programme for conversion into a three-seat, mock-up flight test aircraft. Two prototypes, WJ215 and 216, were ordered as true Mk 7s, but they were in fact the last two Mk 6 airframes (WD924 and 925), to be used "as economically as possible" in the construction of Mk 7 prototypes. WJ215 first flew on 22 May 1951.



Firefly Mk I MB757 is seen here mocked-up with the observer's cockpit, as intended for the Mk 7.



Later, a proper rear cockpit was fitted to MB757. Note also the Mk 6 tailfin.



***Above: The first 'true' Mk 7 was WJ215, which featured the definitive one-piece pilot's canopy and an angular exhaust shroud not repeated on production aircraft. It is seen here aboard HMS* Illustrious.**

Left: WJ216 is seen here carrying streamlined sonobuoy containers and long-range fuel tanks.

Firefly AS.Mk 7/T.Mk 7

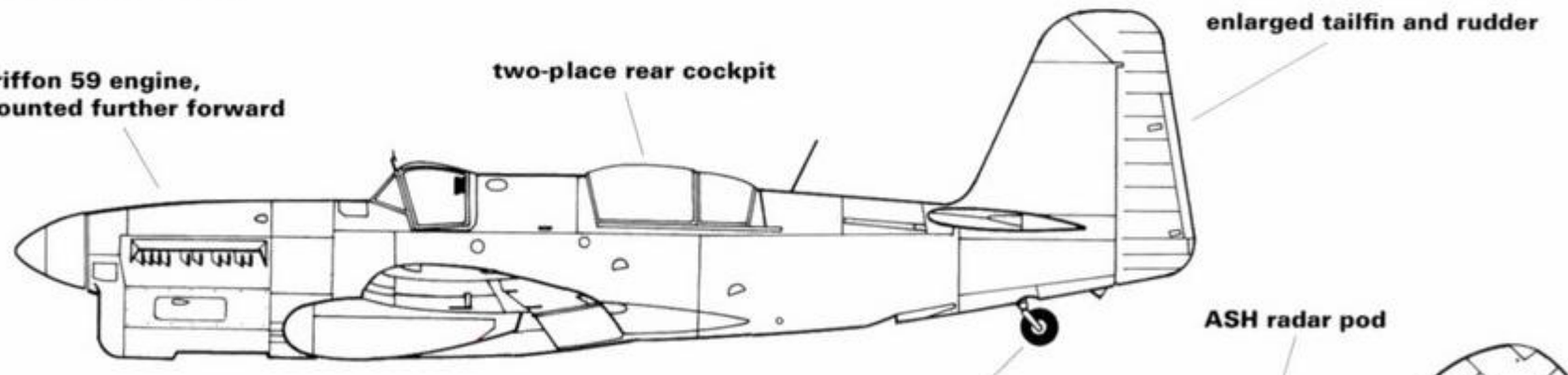
Firefly AS.Mk 7 was to have been the designation for the 337 anti-submarine aircraft planned in the early 1950s to replace the AS.Mk 6. Poor performance during early flight tests was to result in drastic cutbacks in orders and a change to a training role for most of the aircraft accepted by the FAA.

An extra seat was added to the rear cockpit and dual British sonobuoy search equipment was included. The rear cockpit hooding was different to the previous faired-in arrangement. On the Mk 7 it was bulged to allow a better overall view for the observer.

The aircraft's powerplant was a Griffon 59, reverting to single-stage supercharging but with water-methanol injection to boost power on take-off. It was equipped with a chin radiator similar to that intended for the ill-fated Mk III. The overall shape of the Mk 7 was not dissimilar to that of the earlier marks of Firefly except that the centre-section leading edge was tapered and carried bag-type fuel tanks. This revised layout meant the main fuel tank contents were reduced to 89 Imp gal (405 litres). No cannon was fitted but all the usual Mk 6 external stores were able to be carried.

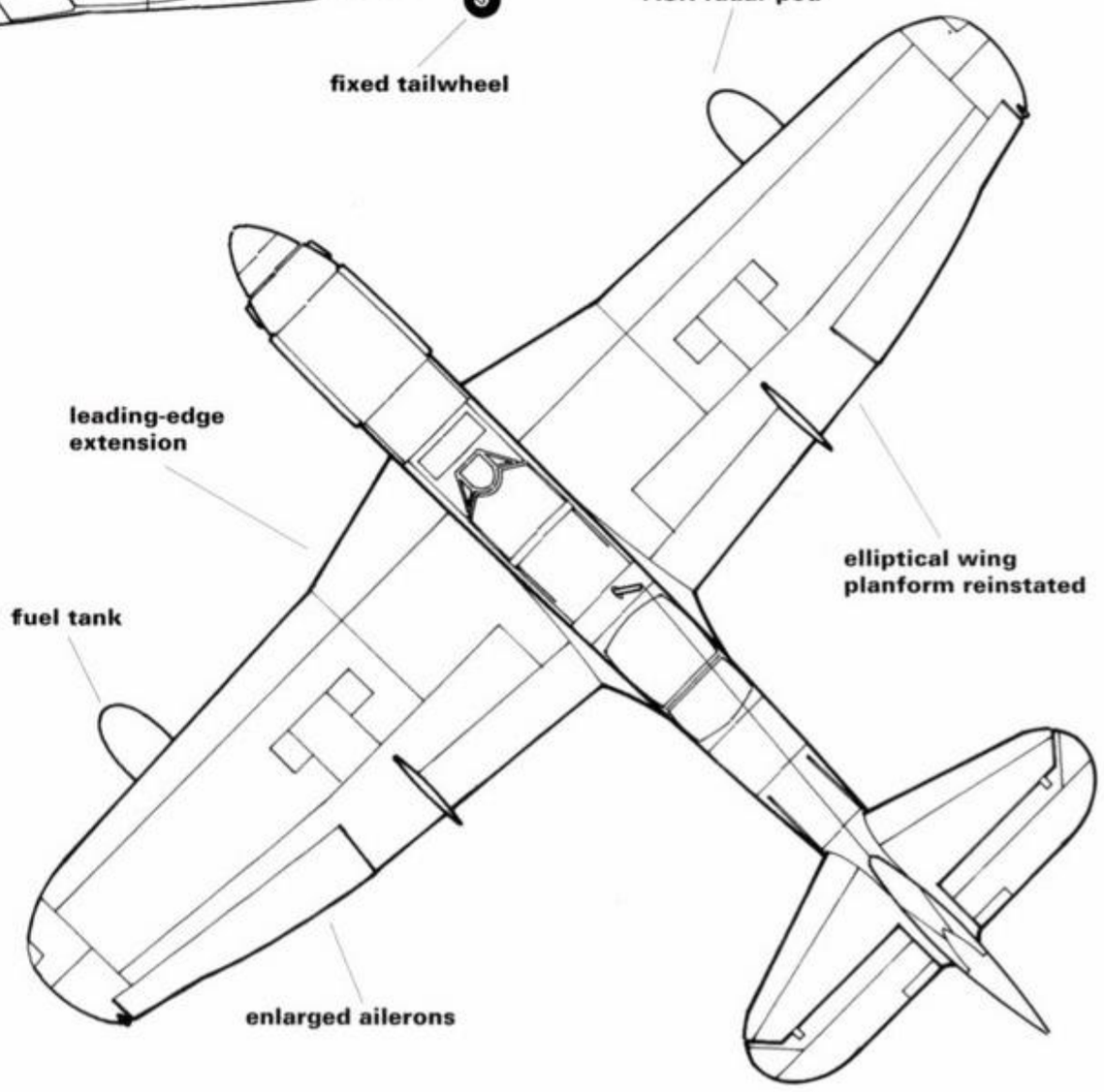
Plagued by handling problems from the outset, the Mk 7 programme was eventually downgraded. When the Ministry of Supply confirmed in April 1952 that the variant was unacceptable for use in the anti-submarine role, it stated that there was a requirement for 160 of the aircraft for use in the training role (as T.Mk 7s) until the introduction of the Fairey Gannet. In addition, 70 would be made available for use by the Controller of Guided Weapons and Electronics.

The overall requirement was again reduced to 151, 110 of which were built at Hayes and 41 at Stockport, with serials WJ146-174, 187-209, 215-216, WK348-373, WM761-779, 796-832, 855-899, WP351-354. Those cancelled were WP355-400, 421-453, 469-490, WV967-991, WW103-128. In the event, only 34 were transferred to the drone programme (as U.Mk 8s).



Firefly Mk 7

The Mk 7 represented the second major redesign of the basic Firefly airframe, WJ154 being an early production example. The availability of Grumman Avenger AS.Mk 4s via the MDAP hastened the Mk 7's demise.



Firefly Mk 7D

The first two true Firefly Mk 7s, WJ215 and WJ216, did all the early development flying for the drone programme from White Waltham. Modified at a later date they became pilot-operated drone testbeds with the designation Mk 7D.

Firefly U.Mk 7

Only one Firefly, WJ194, received this designation when it was used for a short time as a trials aircraft at the RAE, Farnborough in April 1952.

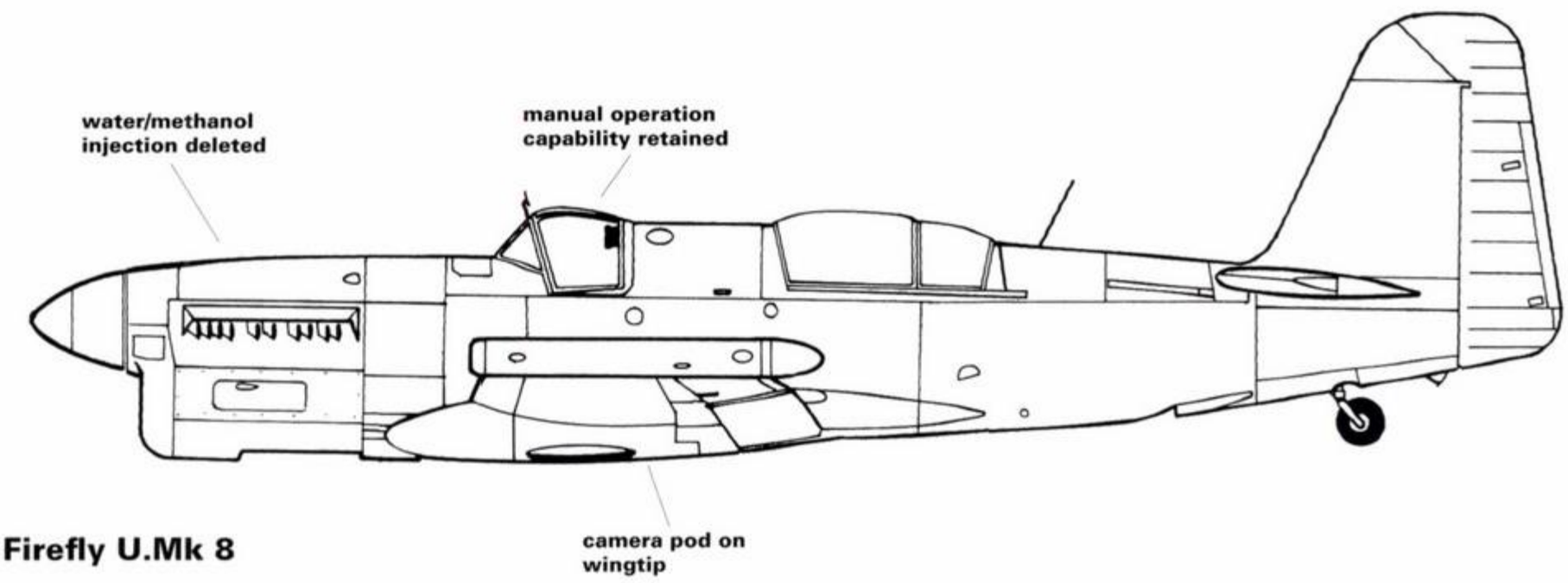
Firefly T.Mk 8

This designation applied to six early drone development machines: WJ147, WJ149, WJ150, WJ151, WJ152 and WJ153. Some were also used as chase aircraft to escort and photograph drone flights. All were later refurbished and brought up to full U.Mk 8 standard. WJ147 survived the longest of all the Mk 8s, being lost at sea on 20 July 1960.

Firefly U.Mk 8

This was a Firefly Mk 7 converted into a pilotless target drone for use at the RAE Llanbedr aerodrome in Wales. The observer's cockpit was stripped of all unnecessary service equipment and a Mk 8 Type 'H' automatic pilot was installed which allowed control from the ground. The pilot's cockpit remained fairly standard, with new throttle controllers fitted and any unnecessary equipment removed, though the aircraft retained the ability to be flown manually when required. As the 176-Imp gal (800-litre) main fuel tank would be adequate for the planned sortie times, the 55-Imp gal (250-litre) nacelle tank was removed. To save weight, many of the items required for service use-but of little utility in the new role were also removed, including the wing-folding mechanism, water/methanol cooling system, ASH nacelle and external wing tank, gun sight, G45 gun camera, radio equipment and cockpit heaters.

A nacelle was mounted on each wingtip which contained five weapon assessment cameras. Plans to convert 70 aircraft were eventually revised to 34, all drawn from the Mk 7 production line. The first machine, WJ150, flew for the first time on 27 November 1953 and after delivery became the first to carry out an operational pilotless sortie. The 34 U.Mk 8s were WM810, WM823, WM856 to WM863, WM880 to 899, and WP351 to WP354. They were very colourful, with their bright red and yellow paint scheme. WP354 was the last of 1,702 Fireflies built and was shot down by a missile on 10 September 1956.



Firefly U.Mk 8

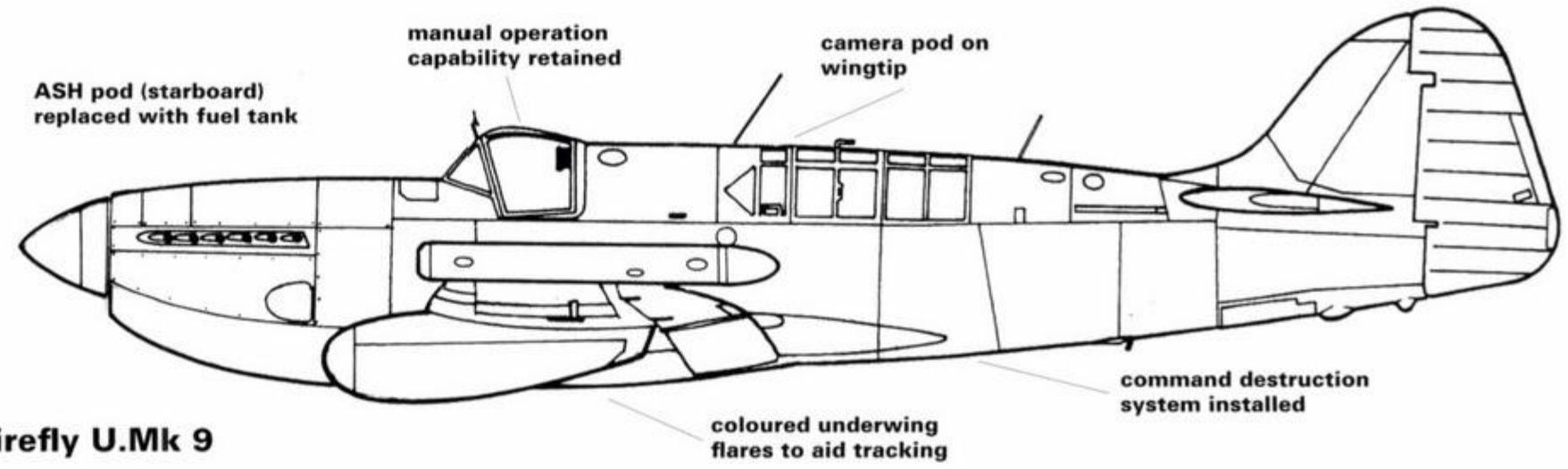
The very last Firefly off the line was this aircraft (WP354), a Mk 7 completed as a Mk 8 drone.

Firefly drones were finished red overall with yellow upper surfaces to aid conspicuity. WM856 was the third Mk 8 conversion.

Firefly U.Mk 9

The flight test aircraft for the U.Mk 9 programme was ex-Mk 5 WB257. It was received by Fairey in 1955 and converted at Ringway. Fairey test pilot David Masters took it on its first (manned) flight on 9 April 1956. Once the trials were over, the aircraft was delivered to No. 728B Squadron where it was unceremoniously shot down on 25 May 1960. At times during the trials it was joined by WB416, which was the first U.Mk 9 to be delivered to No. 728B, on 9 July 1957.

When the requirement arose for more target drones it was found that no more production Firefly 7s or 8s were available, so it was decided to convert a number of surplus Mk 5 Fireflies as target drones in the same way as the Mk 7. As a consequence, 40 were earmarked for conversion by Fairey at Ringway: WB245, WB307, WB331, WB347, WB350, WB365, WB373, WB374, WB382, WB391, WB392, WB394, WB402, WB409 to WB411, VH134, VX416, VX418, VX421, VX427, VX429, VT364, VT370, VT372, VT403, VT413, VT430, VT441, VT461, VT463, VT470, VT481, VT485, VT487, VT493, VT494, and VT497. They were also painted bright red and yellow. The principal user of the U.Mk 9 was No. 728B Squadron operating from Hal Far aerodrome on Malta. The first operational U.Mk 9 sortie was carried out on 8 October 195; the last in November 1961.

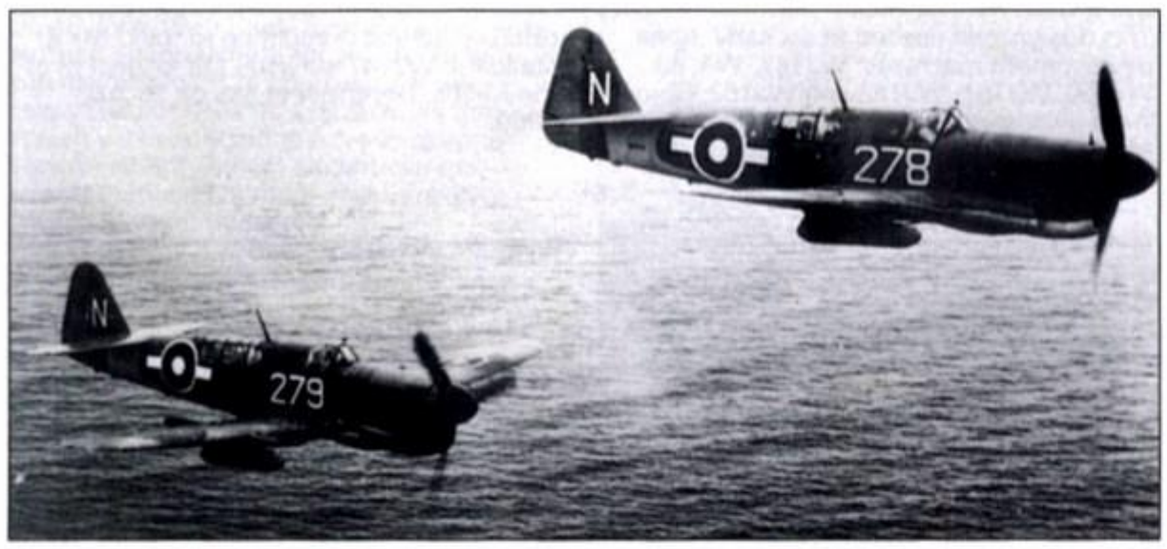

manual operation capability retained
camera pod on wingtip
ASH pod (starboard) replaced with fuel tank
command destruction system installed
coloured underwing flares to aid tracking

Firefly U.Mk 9

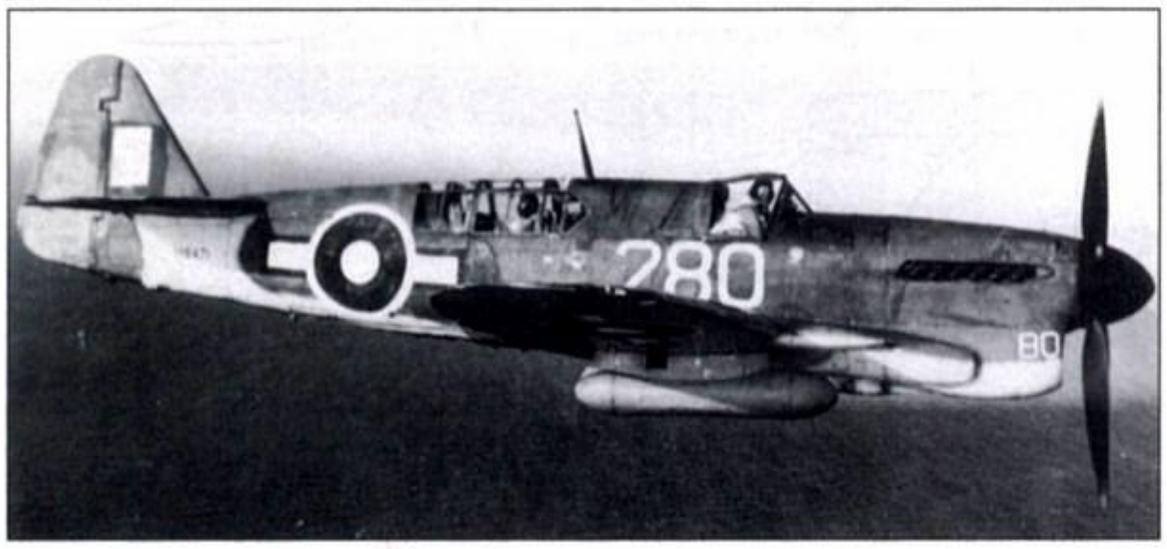
WB257, the U.Mk 9 prototype, poses for the Ministry of Supply photographer. Note that the Mk 9 retained the Mk 5's external tanks.

Fairey Firefly Operators

United Kingdom (Fleet Air Arm)



No. 1771 Squadron Fireflies F.Mk Is from HMS* Implacable, *June 1945.



FR.Mk I MB471 '280' is seen here on a sortie from HMS* Indefatigable. *Passed to No. 812 Squadron at Schofields in NSW, Australia after VJ-Day, the aircraft was written-off in an accident in Ceylon on 20 May 1946, en route to the UK.

This Firefly NF.Mk I carries the codes of No. 1792 Squadron. Later converted to FR.Mk I standard, MB738 subsequently served with Nos 827, 1830, 814 and 766 Squadrons before being struck-off charge in 1954.

Aboard HMS* Vengeance *(tailcode 'Q'), this Firefly Mk 4 of No. 814 Squadron is about to snag the third arrester wire after another sortie during Home Fleet manoeuvres off the coast of Portugal in 1948/49.

No. 1770 Squadron

No. 1770 was the first front-line squadron to receive Firefly F.Mk Is, in December 1943. It joined HMS *Indefatigable* in May 1944 and made its operational debut against the German battleship *Tirpitz* in July 1944. The Firefly was initially used as an escort fighter, particularly in August during minelaying operations off the Norwegian coast. Then it was back for another crack at the *Tirpitz* before sailing to Ceylon (now Sri Lanka) to join the British Pacific Fleet (BPF). In January 1945 the Fireflies, as part of a co-ordinated strike by the BPF, carried out a series of highly successful operations against Japanese-held oil refineries in Sumatra. During these raids a number of Japanese fighters were shot down. Moving to the East China Seas, the squadron escorted Avengers to their targets in the Sakishima Gunto group of islands and then attacked specific targets using RPs, bombs and cannon. A number of aircraft were lost to ground fire. In June the BPF retired to Australia to replenish and No. 1770 was disbanded. Plans to reform the unit were thwarted by the end of the war.

No. 1771 Squadron

No. 1771 Squadron formed up at Yeovilton on 1 February 1944 and, after working up, joined HMS *Implacable*. The squadron made its first operational flight on 18 October 1944 when its Fireflies searched Norwegian fjords, looking for the *Tirpitz*. Strikes were made against German targets along the Norwegian coast, in which a number of flying-boats were destroyed. On 27 October one of the squadron's Fireflies was shot down by a U-boat, but a later strike left the German submarine floating on its side. During this series of patrols three large German ships were attacked, with two driven ashore and the other damaged; three smaller vessels were also damaged. More enemy shipping was attacked and damaged during December prior to the aircraft embarking in *Implacable* to sail for Australia. Task Force 111/2 was formed under Rear Admiral Brind to keep up the pressure on the Japanese when the BPF returned to Australia to replenish.

On 17 July No. 1771, operating from *Implacable*, sent its Fireflies against Matsushima airfield and rail targets in northern Honshu. This was the first occasion on which British aircraft had flown over the Japanese mainland. Operating on an almost continuous daily basis, strikes were made against enemy shipping, airfields, harbours, supply dumps, vehicle parks and other military targets. Some Fireflies were lost to ground fire. On 24 July two Fireflies of No. 1771 accompanied by two Corsairs and six Avengers found the Japanese escort carrier *Kaiyo*, which was attacked and left on fire with a broken back. This was the only known strike against an enemy aircraft-carrier by the British in World War II. In mid-August, *Implacable* withdrew to Australia for urgent repairs. No. 1771 was disbanded at Nowra on 16 October 1945.

No. 1772 Squadron

No. 1772 formed up on 1 May 1944 at Burscough in Lancashire. Deck landing training was carried out on HMS *Empress* during November, after which the original Firefly F.Mk I aircraft were handed over to No. 766 Squadron. No. 1772 received new aircraft with long-range tanks, and with them the squadron embarked in HMS *Ruler* on 20 January 1945, sailing to join the BPF. The squadron flew ashore to Schofields near Sydney on 18 March and during the next six weeks was involved in weapon training. Four complete crews were seconded to No. 1770 aboard *Indefatigable* for combat experience, and this proved invaluable not long afterwards when No. 1772 replaced No. 1770 Squadron. Their primary role was as escort fighters to the Avengers, after which they attacked specified target and, later, targets of opportunity. During July and early August, strikes were made on enemy airfields, shipping, harbour installations and trains, while armed reconnaissance flights were also undertaken. Again, a number of Fireflies were lost to enemy ground-fire. At 07.00 on 15 August, all strikes were cancelled pending the unconditional surrender of Japan.

On 27 August No. 1772 found itself tasked with locating camps with Allied POWs on Nagoya and Shingu, to which it dropped medical supplies. On 2 September, the squadron carried out its last operational sweep, flying over Yokaichi POW camp. Upon its return to Australia, No. 1772 joined the 7th Carrier Air Group (CAG) for a goodwill visit to New Zealand before returning to the UK in early 1946 and disbanding on 10 March 1946. Three other day squadrons – Nos 1773, 1774 and 1775 – were to have formed up and joined the war in the Far East, but these plans were abandoned upon the cessation of hostilities.

No. 1790 Squadron

No. 1790 broke new ground by becoming the first naval night-fighter squadron. When the unit formed up at Burscough on 1 January 1945 it was equipped initially with Firefly F.Mk Is, but these were replaced by NF.Mk Is with ASH radar as they became available. The squadron embarked in HMS *Vindex* for passage to Australia, but by the time it arrived the war was over. In April 1946 the squadron returned to the UK aboard HMS *Implacable* and was disbanded on 3 June 1946.

No. 1791 Squadron

No. 1791, the second night-fighter squadron, formed up at Lee-on-Solent on 15 March 1945 with Firefly NF.Mk Is. Deck landing practice was carried out on HMS *Puncher* in June, but VJ-Day led to the unit's disbandment on 23 September 1945.

No. 1792 Squadron

No. 1792 Squadron became the third night-fighter squadron to form up at Lee-on-Solent, on 15 May 1945, with Firefly NF.Mk Is. VJ-Day occurred shortly after work-up, removing the purpose for which the unit had been formed. In December 1945 the squadron embarked in HMS *Ocean* for comparative trials to determine whether the future lay in single-seat or two-seat night-fighters; both the FAA and USN eventually opted for the twin-seat arrangement. The FAA, in the immediate post-war era, decided not to have full night-fighter squadrons, and instead formed 'Black Flights', which consisted of four Fireflies attached to a front-line squadron. This practice eventually led to the operation of all-weather jet fighters from carriers. No. 1792 was disbanded upon its return to the UK, on 17 April 1946.

No. 812 Squadron

No. 812 was operating Barracuda Mk IIs in the Far East when the war finished. It swapped its Barracudas for Firefly FR.Mk Is in Australia in January 1946, but was disbanded on its return to the UK in August. The squadron reformed on 1 October 1946 at Eglinton with Firefly FR.Mk 1s as part of the 14th CAG. It joined HMS *Theseus* in February 1947 for a cruise to the Far East, returning in November. FR.Mk Is were

exchanged for Firefly FR.Mk 4s in March 1948, these being replaced with Firefly Mk 5s in July.

Four Firefly NF.Mk Is came from 816 Squadron to provide a Black Flight for the squadron. HMS *Ocean* ferried the squadron to Malta where it was shore-based at Hal Far. In September 1949 the squadron flew back to Culdrose to exchange its Mk 5s for later-build examples. Returning to Hal Far, the squadron embarked in HMS *Glory* in November for a series of exercises and goodwill visits. In February 1951 the Black Flight was disbanded and the 14th CAG sailed for Korea. The first operational patrol was on 28 April with strikes at enemy shore targets. No. 812 was relieved by HMS *Ocean* with the 17th CAG. The Firefly Mk 5s were replaced with AS.Mk 6s in June 1952 and, after cruises in HMS *Eagle* and *Theseus*, the squadron was disbanded at Eglinton on 20 October 1953 to reform with Gannets.

No. 814 Squadron

This unit, like No. 812 Squadron, had been operating Barracuda Mk IIs in the Far East when the war ended. In December it exchanged the Barracudas for Firefly FR.Mk Is in Australia. Although too late to participate in the war, the unit stayed in the area, operating either from HMS *Venerable* or ashore. After re-equipping with the Firefly FR.Mk 4, No. 814 spent some time aboard HMS *Vengeance* before returning in the new year to receive the Firefly Mk 5.

No. 814 was disbanded at Culdrose in November 1950 in anticipation of receiving the new AS.Mk 6. These aircraft were not available, so the squadron used FR.Mk Is until January 1951 when the first AS.Mk 6 arrived. With them, No. 814 joined No. 809 Squadron (with Sea Hornet NF.Mk 21s) to form the 7th Night Air Group, the first FAA Air Group tasked with night-fighting. After spells in HMS *Theseus* and *Eagle*, No. 814 re-equipped with Avenger AS.Mk 5s in 1954.

Above: Seen over Glasgow in the early 1950s, this Mk 6 of No. 1830 Squadron, based at Abbotsinch, was under the control of the Scottish Air Division of the RN Volunteer Reserve.

Below: During 1945, early production Mk I Z2035 served with No. 730 Squadron at Ayr.

No. 804 Squadron

No. 804 Squadron, a Sea Fury unit, operated a few Firefly Mk 5s between June and December 1949.

No. 805 Squadron

No. 805 operated both FR.Mk I and NF.Mk I Fireflies, but only for a brief period. The unit was part of the 20th CAG flying Seafire F.Mk XVs, but when embarked in HMS *Ocean* problems with the Seafire's Griffon VI engine shortcomings saw the type banned from deck operations. Thus, from August 1946 until April 1947, No. 805 operated the Fireflies as single-seat fighters until Seafire F.Mk 17s became available.

No. 810 Squadron

Receiving its first new FR.Mk 4s when it reformed at Eglinton as part of the 17th CAG in 1 October 1947, No. 810 Squadron spent the next two years embarked in HMSs *Implacable* and *Theseus* for various exercises and cruises. On 17 October 1949 it re-equipped with the AS.Mk 5, taking on a dedicated anti-submarine role. Mk 4s served alongside the Mk 5s until June 1950, by which time the squadron had received its full quota of Mk 5s.

Embarked in *Theseus* with the 17th CAG in September, No. 810 sailed for Korea where the unit was tasked (with the Sea Furies of No. 807 Squadron) with blockading the enemy-held west coast. Operations began on 9 October 1950, and by the end of the year the 17th CAG had been awarded the Boyd Trophy, presented each year to an outstanding unit. Upon its return to the UK, No. 810 was disbanded, on 17 December 1953.

No. 816 Squadron

Formed on 1 July 1945 with Firefly FR.Mk Is as part of the 20th CAG, No. 816 Squadron received a Black Flight with four Firefly NF.Mk Is the following May, and in June the unit embarked in HMS *Ocean*.

The air group was in the Mediterranean when the UK renounced its Mandate in Palestine, and No. 816's Fireflies provided cover for the British withdrawal. No. 816 returned to the UK in June 1948 and was disbanded at Lee-on-Solent the following month; it reformed at the end of August as a Royal Australian Navy squadron equipped with Firefly FR.Mk 4s.

No. 820 Squadron

No. 820 Squadron formed at Eglinton on 3 July 1951 as an anti-submarine squadron with Firefly AS.Mk 5s. By December these had been replaced with the AS.Mk 6s, the unit embarking in HMS *Indomitable*. There then followed periods aboard HMSs *Indomitable* and *Theseus*, on which the squadron flew extensive night trials.

The squadron was one of numerous Firefly units that participated in the Coronation Review Flypast at Spithead on 15 June 1953. The Fireflies gave way to Avenger AS.Mk 4s in February 1954.

Above: The Trials and Requirements Unit, No. 700 Squadron, operated a variety of jet-, turbine- and piston-engined types in 1955, including this TT.Mk 4, one of nine based at RNAS Ford with the unit.

No. 821 Squadron

No. 821 formed up at Eglinton as an anti-submarine squadron with Firefly AS.Mk 6s on 18 September 1951. After deck-landing training aboard HMS *Illustrious*, the squadron continued to work up but was re-roled in May 1952 as a strike squadron. Re-equipping with the Firefly FR.Mk 5, the unit moved to Malta and joined HMS *Glory* in September to sail for Korean waters.

En route, the squadron supported British ground forces in Malaya, bombing and strafing terrorist positions. The first Korean patrol began on 12 November 1952, the Fireflies attacking a bridge near Changyou. HMS *Ocean* relieved *Glory* on 17 May, and upon arrival in Hong Kong on 25 May 1953 the squadron was disbanded.

No. 796 Squadron T.Mk 3s closely formating for the camera include PP523 '264' and PP425 '280'. As an Aircrewman's School, No. 796 flew T.Mk 3s until 1954, when T.Mk 7s took over the training role.

FR.Mk 5s of No. 810 Squadron overfly the destroyer HMCS **Nootka** *on their return to HMS* **Theseus** *after a strike against enemy targets.*

Ford in the mid-1950s was home to FR.Mk I MB739 509/'FD' and TT.Mk 4 VG959 502/'FD' of No. 771 Squadron.

Above: The cluttered deck of HMS **Eagle** *hosts AS.Mk 6s of Nos 812 and 814 Sqns. In the background are Sea Hornets and two Skyraider AEW.Mk 1s.*

Below: Prior to another manned flight from Hal Far, drone Mk 9 VT487 of No. 728B Squadron is seen here being refuelled.

T.Mk 7 761/'CU' was based at RNAS Culdrose with No. 796 Squadron in 1956.

No. 822 Squadron

No. 822 Squadron was bound for the BPF equipped with Barracuda Mk IIs, but after VJ-Day re-equipped with Firefly FR.Mk Is. It disbanded on 19 February 1946.

No. 824 Squadron

Like No. 822, No. 824 was equipped with Barracuda Mk IIs and destined for action with the BPF but was thwarted by the end of hostilities. It formed up at Ayr in August 1945 with Firefly FR.Mk Is, but was disbanded at Burscough on 4 January 1946. The squadron reformed on 18 February 1952 as an anti-submarine unit with the Firefly AS.Mk 6. There then followed some spells aboard HMS *Illustrious* and *Theseus*, and on 15 June No. 824 joined the other squadrons taking part in the Coronation Review Flypast. In July the squadron relinquished its Fireflies for Avenger TBM-3Es.

No. 825 Squadron

No. 825, also equipped with Barracuda Mk IIs and earmarked for a deployment with the BPF which was cancelled, re-equipped with Firefly FR.Mk Is in November 1945. Squadron personnel had consisted mainly of Canadian nationals and in January 1946 it transferred to the Royal Canadian Navy.

The squadron number was reactivated on 12 June 1951, No. 825 receiving Firefly AS.Mk 5s as part of the 15th CAG. In November the squadron received FR.Mk 5s for the strike role. As part of the 17th CAG it embarked in HMS *Ocean*, which relieved HMS *Glory* off the Korean coast. Operations followed until November, when *Ocean* was relieved by *Glory*, back for a third time. For its part in the Korean conflict that year, 1952, the squadron was awarded the Boyd Trophy, sharing it with its shipmates of No. 802 Squadron (Sea Furies).

Upon arrival in the UK on 10 December 1952, No. 825 was disbanded. The unit reformed as an anti-submarine unit on 2 March 1953 with Firefly AS.Mk 5s. After taking part in the Coronation Review Flypast on 15 June, the squadron had a couple of spells aboard HMS *Eagle* before joining HMS *Warrior* on a trip to the Far East. During May it carried out RP sorties against terrorists in the Malayan jungle and then cruised home to disband on 30 December 1954 (and reform the next year with Gannets).

No. 826 Squadron

No. 826 formed up at East Haven on 15 August 1945 with Barracuda Mk IIs equipped with ASH radar, and was manned mainly by Canadian Navy personnel. A planned move to the Far East was cancelled after VJ-Day and in January 1946 the squadron received Firefly FR.Mk Is, only to disband on 28 February 1946.

The squadron number was reserved for use by the Royal Canadian Navy and was taken up when the unit reformed at Dartmouth in Nova Scotia. The FAA reformed the squadron at Ford on 15 May 1951 with Firefly AS.Mk 6 aircraft. Over the next four years the squadron operated from HMS *Illustrious*, *Indomitable*, *Theseus* and *Glory*, with spells ashore in Malta. It returned to Lee-on-Solent to take part in the Coronation Review Flypast and early in 1955 relinquished its Fireflies for Gannets.

No. 827 Squadron

No. 827 became a Firefly FR.Mk I squadron on 15 August 1946 when it reformed at Eglinton. As part of the 13th CAG it embarked in HMS *Triumph* for a two-year spell in the Mediterranean. In August 1949 the ship sailed for the Far East, where operations against Malayan terrorists were mounted in support of the British forces there. HMS *Triumph* was still in Far Eastern waters when the Korean War broke out, and was quickly put into action. Operations commenced on 3 July 1950 when 12 Firefly FR.Mk Is of No. 827 and seven Seafire FR.Mk 47s of No. 800 Squadron attacked Haeju airfield with RPs. They were the oldest operational front-line aircraft in the FAA and prove a real trial to those charged with their operation and maintenance. Day-to-day operations took their toll on the old aircraft and on 20 September, when HMS *Theseus* arrived with the 17th CAG, No. 827 had only two machines suitable for combat, though the engineering officer said he would not have allowed them to fly in peacetime.

Theseus sailed for the UK, and upon arrival in November 1950 its aircraft were flown ashore, ending the front-line service of both the Firefly FR.Mk 1 and Seafire.

No. 837 Squadron

No. 837 had been sent to join the BPF with Barracuda Mk IIs but saw no action. Embarked in HMS *Glory* the squadron sailed to Rabaul to cover any unrest during the Japanese surrender. Then it was back to Australia to re-equip with Firefly FR.Mk Is to rejoin *Glory*, and a spell in the East Indies and Far East. The squadron was disbanded upon its return to the UK in October 1947.

These Mk 7s of No. 719 Squadron, seen in 1953, wear Eglinton tailcodes.

Second-line units

The following second line squadrons operated Fireflies (listed here by mark):

Firefly F.Mk I/FR.Mk I
Nos 700, 703, 706, 719, 730, 731, 736, 737, 741, 744, 748, 759, 764, 766, 767, 768, 771, 772, 778, 780, 781, 782, 783, 787, 790, 795, 796, 798 and 799 Squadrons and Nos 1830 and 1841 Squadrons, RNVR

Firefly NF.Mk I
Nos 732, 746, 784, 792 and 794 Squadrons

Firefly T.Mk 1
Nos 736, 737, 744, 764, 766, 767, 771, 778, 781, 782 and 799 Squadrons and Nos 1830 and 1831 Squadrons, RNVR

Firefly NF.Mk II
Nos 746 and 772 Squadrons

Firefly T.Mk 2
Nos 737, 744, 764, 765, 766, 771, 781, 782 and 799 Squadrons and Nos 1830, 1833, 1840, 1841 and 1844 Squadrons, RNVR

Firefly T.Mk 3
Nos 796 Squadron and Nos 1830, 1831, 1833, 1841 and 1844 Squadrons, RNVR

Firefly FR.Mk 4
No. 1840 Squadron, RNVR

Firefly TT.Mk 4
Nos 700 and 771 Squadrons

Firefly AS.Mk 5/FR.Mk 5
Nos 703, 703A, 719, 737, 737X, 778, 781, 782 and 796 Squadrons, Nos 1830 and 1844 Squadrons, RNVR and the Royal Navy Historic Flight

Firefly AS.Mk 6
Nos 703, 703X, 719, 737, 737X, 744, 751, 767, 771, 782 and 796 Squadrons and Nos 1830, 1840, 1841 and 1844 Squadrons, RNVR

Firefly T.Mk 7
Nos 719, 750, 765 and 796 Squadron and No. 1840 Squadron, RNVR

Firefly U.Mk 9
No. 728B Squadron

A Mk 5 of No. 826 Sqn completes the 1,000th accident-free landing aboard HMS Ocean, 10 July 1952, flown by Commissioned Pilot R. M. Brand, RN.

Australia (Royal Australian Navy)

The RAN operated Fireflies for over 10 years, eventually receiving 108 Mk 5s and 6s, of which a number were converted for secondary roles. With the help of the British government, the post-war RAN FAA was launched on 28 August 1948 when the 20th CAG, comprising No. 816 Squadron with Firefly Mk 5s and No. 805 with Sea Furies, formed up at Eglinton. In April 1943 a 'Majestic'-class aircraft-carrier was laid down and in September 1944 was launched as HMS *Terrible*; at the end of hostilities, the ship was laid up until acquired by the Australian government and renamed HMAS *Sydney*.

In April 1949 the ship embarked the 20th CAG and sailed for Australia. Shore bases were at Nowra and Jervis Bay. *Sydney* returned to the UK in November 1950 to embark a second air group, the 21st CAG, made up of No. 817 Squadron with Firefly 5s and No. 808 with Sea Furies. Back in Australia they were joined by the Sea Furies of No. 805 Squadron and *Sydney* sailed for Korean waters.

Its first patrol off the west coast began on 4 October 1951, during which 10 aircraft were lost on operations and 77 damaged. *Sydney* was replaced by *Glory* but returned after the armistice for a further spell, during which its aircraft patrolled the Korean coast.

The RAN operated two other carriers, HMS *Vengeance*, on loan from the RN from November 1952, and HMAS *Melbourne*, which had been laid down like *Sydney* as a 'Majestic'-class carrier during the war and taken over by the RAN in 1949. Both carriers operated Fireflies at various times.

No. 816 Squadron

No. 816 started to replace its FR.Mk 4s with FR.Mk 5s in March 1949, and the following year added AS.Mk 6s to its inventory. The squadron joined *Sydney* in September 1953 for a spell in Korean waters and changed back to the Firefly FR.Mk 5s at Sembawang in November. After a spell in the Far East the squadron re-equipped with the AS.Mk 6. It was disbanded upon its return to Nowra on 27 April 1955.

No. 817 Squadron

After its spell in Korea, No. 817 joined *Sydney* for a cruise to the UK and took part in the Coronation Review Flypast in June 1953. After short spells in *Vengeance* and *Sydney*, the squadron was disbanded at Nowra on 27 April 1955.

No. 851 Squadron

No. 851 Squadron formed up at NAS Nowra on 3 August 1954 as an anti-submarine training unit operating the Firefly Mk 6. The squadron disbanded on 13 January 1958.

Second-line units

Training squadrons operating the Firefly included Nos 723, 724 and 725 Squadrons.

Above: This busy scene aboard HMAS Sydney was recorded in 1955, as Firefly Mk 6s of No. 817 Squadron prepare to leave its deck.

Below: Firefly AS.Mk 5 VX386 912/'NW' served with No. 723 Squadron at Nowra in 1955. Reformed by the RAN three years earlier, No. 723 performed fleet requirements, communications, air-sea rescue and refresher flying duties with a variety of aircraft.

Coded 962/'NW', T.Mk 5 (or 'Mk 5 T.2') VX373 poses at Nowra while with No. 723 Sqn during 1954/55. Note the 'last two' on the undercarriage door.

Canada (Royal Canadian Navy)

The Royal Canadian Navy operated 62 Fireflies, comprising 26 FR.Mk Is, three T.Mk 1s, three T.Mk 2s, 12 FR.Mk 4s and 18 AS.Mk 5s, most on loan from the RN. Agreement was reached with the British Admiralty for assistance in forming a naval air branch. Two light aircraft-carriers, HMCS *Warrior* and *Magnificent*, were allocated for this purpose.

In March 1946 *Warrior* took on board the Firefly FR.Mk Is of No. 825 Squadron and the Sea Furies of No. 803, arriving in Nova Scotia on 31 March. These squadrons operated from the *Warrior* and shore bases until April 1947, when they became the 19th CAG. The FR.Mk Is were handed over to No. 826 Squadron to form the 18th CAG at Dartmouth, Nova Scotia, with No. 883 Squadron and its Sea Furies. Meanwhile, No. 825 had returned to the UK to re-equip with the Firefly FR.Mk 4 and returned aboard the new carrier, HMCS *Magnificent*. In November 1948 both Firefly squadrons were joined to form a new 18th CAG. Early in 1949 it returned to the UK and exchanged its FR.Mk 4s for AS.Mk 5s.

On 1 May 1951 all the RCN squadrons were renumbered, allowing the original number plates to revert to the RN. Of the 26 FR.Mk Is, nine were sold to Ethiopia, four returned to the UK, four were scrapped, five crashed in service and four went to Denmark. Five of the trainers were sold to Ethiopia. Of the AS.Mk 5s, nine were written off, nine returned to the UK and four were sold to the Dutch navy.

Above: AS.Mk 5s of No. 825 Squadron formate for the photographer. Mk 5s operated by the RCN differed from RN aircraft only in the type of underwing sonobuoy employed. Canadian aircraft used AN/CRT-1s. Maple leaves appeared in roundels of RCN aircraft after an official instruction to that effect was issued on 19 January 1946.

RCN Firefly FR.Mk 1 PP402 was one of 26 delivered for use by No. 826 Squadron until February 1947. The 'AB' codes reflected the unit's callsign; 'VG' (on the underside of the wing) was the RCN ICAO code.

Denmark (Royal Danish Air Force)

In 1951 the Royal Danish Air Force (RDAF) ordered two Firefly TT.Mk 1s to replace older aircraft. Two machines, Z1842 and Z2020, were bought back from the FAA by Fairey and converted at its Stockport-Ringway factory. These became 625 and 626, respectively, in RDAF service.

Four further aircraft were acquired from Canada in 1952 under the Mutual Defence Assistance Programme: 627 (ex-PP413), 628 (PP457), 629 (PP460) and 630 (MB579). Built as FR.Mk 1s these aircraft were converted at the RDAF workshops at Vaerlose using drawings supplied by Fairey. Three Fireflies were lost in accidents and the other three were used until May 1959, when they were sold to Svensk Flygtjansk, the Swedish civil target tug operator.

Z1842, the 13th production Firefly, became 64-625 (the prefix was never applied to the aircraft) in RDAF service in 1951. Aircraft 627 was damaged beyond repair in a heavy landing in January 1955, 629 was wrecked in a similar accident two years later and 628 made a forced landing the following month. The surviving aircraft were sold in 1959; 625 became SE-CHL and saw another five years' service in Sweden.

Ethiopia (Imperial Ethiopian Air Force)

Above: Most of the Fireflies in this scene at Addis Ababa are from the ex-RCN batch. The aircraft nearest the camera carries local camouflage; the rest retain their two-tone Canadian colours. In the background are IEAF Saab 17As and a Douglas C-47.

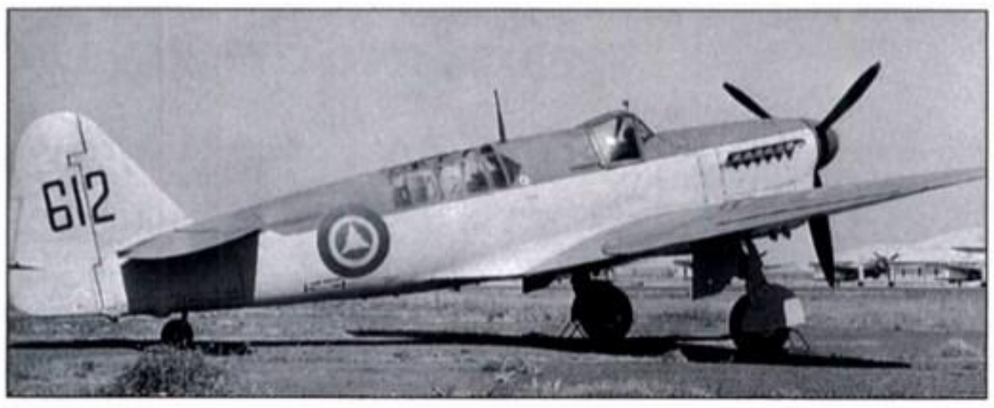
Left: Among the last Fireflies to fly in anger, IEAF Mk Is saw combat against 'dissidents' along Ethiopia's disputed borders.

Having tried unsuccessfully to obtain 'six fighters and six bombers' from the British government through official channels, Ethiopia attempted to secure a dozen Firefly trainers plus a few target-towing examples via the 'back door', the intention being that they be converted back to operational standard to provide the IEAF with 'modern' aircraft.

To this end Count von Rosen, then Commander-in-Chief of the IEAF, approached Fairey directly in May 1950, asked for 35 new Fireflies to form a strike wing. He would have preferred Firefly Mk 5s but they were all needed to support operations in Korea, and he settled for FR.Mk 1s. The first eight FR.Mk 1s and one T.Mk 2 trainer were reconditioned at Fairey's Stockport/Ringway factory and delivered in 1951, comprising 601 (MB434), 602 (MB476), T.Mk 2 603 (MB382), 604 (MB497), 605 (MB737), 606 (Z2026), 607 (Z2100), 608 (Z1955) and 609 (Z1982). They were used operationally along the borders with Sudan and Somalia to contain dissidents. The rest of the order for 26 Fireflies was never fulfilled due to problems between the UK Foreign Office and Ethiopia.

However, the Ethiopians bought 14 surplus Fireflies from Canada: nine FR.Mk 1s (DK535, 537, 545, 560, 561, 565, PP402, 462, 467), three T.Mk 1s (DK445, DT975, MB443) and two T.Mk 2s (MB694 and PP408). Although the Ethiopians informed Fairey that they had acquired nine Fireflies from the Dutch navy, there is no evidence to support this claim and it was believed that they were in such a poor state that the deal never went through.

The surviving Fireflies were still in a hangar at Asmara, their engines inhibited, as late as 1969 but with the arrival of US advisors and US equipment, the aircraft were pushed outdoors and spent the next 20 years or so languishing in the sun. At least four were rescued in the mid-1990s – two for Canada (DK560, now with the National Aviation Museum, Ottawa and PP462 at the CFB Shearwater Aviation Museum, Nova Scotia) and two for South Africa (FR.Mk I 612 and T.Mk 2 610) which were expected to provide enough parts to restore at least one to flying condition.



This 'IEAF HQ photo', dated March 1963, is perhaps not all that it appears to be, the print having clearly been altered to include the serial number. Finished in RCN colours, this is one of those aircraft acquired from Canada.

Five aircraft from the first Firefly order (including a T.Mk 2) congregate at Ringway prior to delivery. Camouflage, national markings and serial numbers were applied by Fairey after conversion. Wing drop tanks were presumably a necessity for the delivery flight to the north African state.

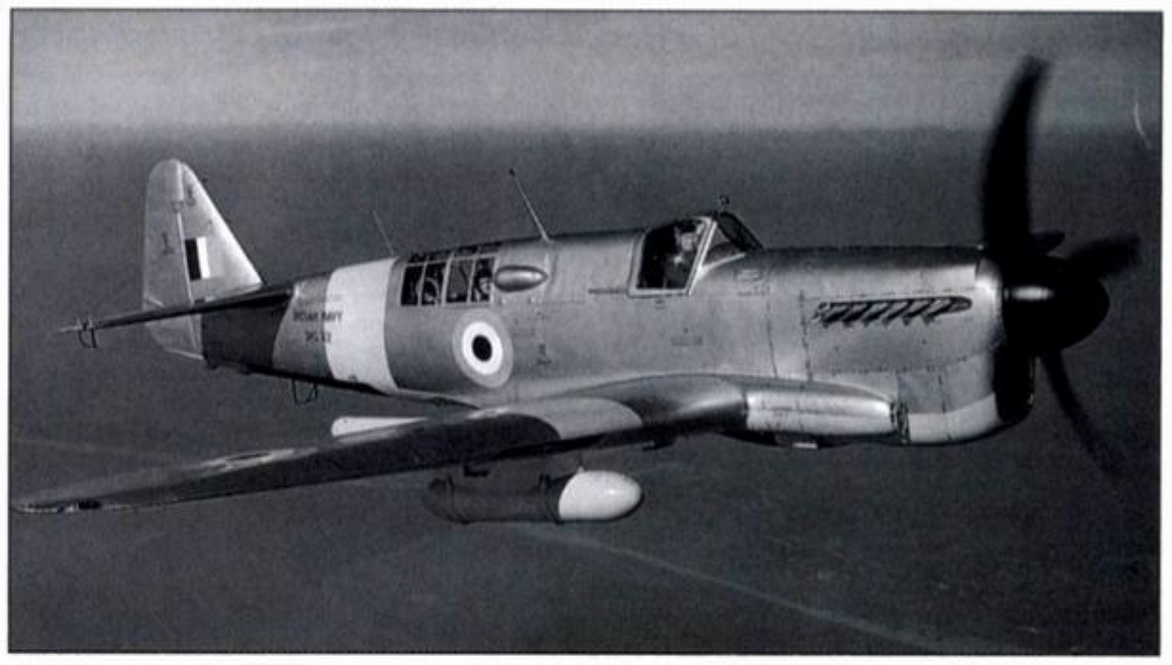
India (Indian Navy)

An order for five Firefly TT.Mk 1s was placed by the Indian Navy in 1953. The aircraft were delivered the following year after being reconditioned and converted at Fairey's Hamble factory. The aircraft were serialled as follows: INS111 (ex-DK566), INS112 (DK477), INS113 (PP488), INS114 (DK479) and INS115 (DK552).

All were used by No. 550 Squadron at Cochin for target-towing and other fleet duties until 1956. By then, acquiring spares for the Firefly was becoming a problem and an order was placed for five Firefly TT.Mk 4s. These were reconditioned and converted in the Stockport-Ringway factory and delivered in 1958, comprising INS116 (VG964), INS117 (VG985), INS118 (TW749), INS119 (VH128) and INS120 (VG980).

General wear and tear and the ongoing spares problem eventually led to their withdrawal from service, although one was retained for a planned Indian Navy museum at Cochin.

The all-over silver finish of INS112, the second of the Indian TT.Mk 1s, gleams in the sun during a pre-delivery flight. Upon the retirement of the Firefly fleet, all but one aircraft were scrapped. The remaining machine was set aside for eventual display at the Indian Naval Museum, Cochin. Last noted in the late 1960s, its present whereabouts are a mystery.



Netherlands (Royal Netherlands Naval Air Service)

In 1945, with the war in Europe barely over, Fairey won an order for 30 Firefly FR.Mk Is from the Royal Netherlands Naval Air Service (MLD). The MLD needed modern strike aircraft with which to contain the impending rebellion in the Dutch East Indies. With Admiralty and Foreign Office agreement, the 30 Firefly Mk 1s were built on the same production line as RN examples at Fairey's Hayes factory. These aircraft were serialled F-1 to F-10 in MLD service and were built with FAA serials in the PP range, as follows: PP458, '472, '473, '489, '487, '484, '486, '492, '493, '474, '527, '497, '528, '494, '526, '583, '590-'593, '601-'603, '606, '607, '614-'616, '619, '623.

The first squadron, No. 860, worked up at the RN base at St Merryn prior to embarking in the carrier HNMS *Karel Doorman*, which was the ex-RN carrier HMS *Nairana*. Fifteen Fireflies disembarked at Kemajoran airfield in Java on 12 October 1946, and were soon in action supporting ground forces with RP and cannon. These operations continued until 1951 when, after more than 2,000 operational sorties by the Fireflies, the Dutch East Indies became Indonesia. The Firefly Mk 1s were operated by Nos 860, 861 and 1 Squadrons, the latter operating in the Netherlands Antilles.

Four of the FR.Mk 1s were later converted to T.Mk 1 trainer standard by Fairey in the UK (L-11 to L-14; later U-11 to U-14 from F-1, F-12, F-8 and F-4, respectively). These were followed by another three T.Mk 2s converted by Aviolanda of Papendrecht using drawings from Fairey: L-15, U-16 and U-17 (ex-F-5, F-23 and F-29, respectively)

In late 1946 the MLD ordered 40 new Firefly FR.Mk 4s (serialled K-31 to K-70). These entered service from 1947; the last seven were retired in 1961. The FR.Mk 4s served with No. 1 Squadron in the Netherlands Antilles, Nos 2, 3, and 4 Squadrons in the Netherlands, and No. 7 Squadron at Biak in Netherlands New Guinea. Eight were later converted to the target-towing role as TT.Mk 4s.

At the beginning of 1949 the MLD ordered 15 new Firefly NF.Mk 5s (K-71 to K-84) which were spread around the FR.Mk 4 units to provide a night-fighter element. Like the Mk 4s, they were finally retired in 1961.

In February 1953 the MLD acquired four Firefly AS.Mk 5s from Canada (P-86 to P-89, ex-VH139, VH141, VX414 and VX415, respectively), of which two flew until 1957 and the other two were used as spares. Sadly, not one Dutch-operated Firefly seems to have survived.

Above: Seen at Heston prior to delivery to the MLD in 1946, Firefly FR.Mk 1 F6 was formerly PP484 and is finished in the standard FAA camouflage of the day, with inverted orange triangle makings on the forward fuselage and rudder.

Above left: The same aircraft as that above is here seen later in full MLD colours and markings, serialled '11-6'. This machine served until 1952.

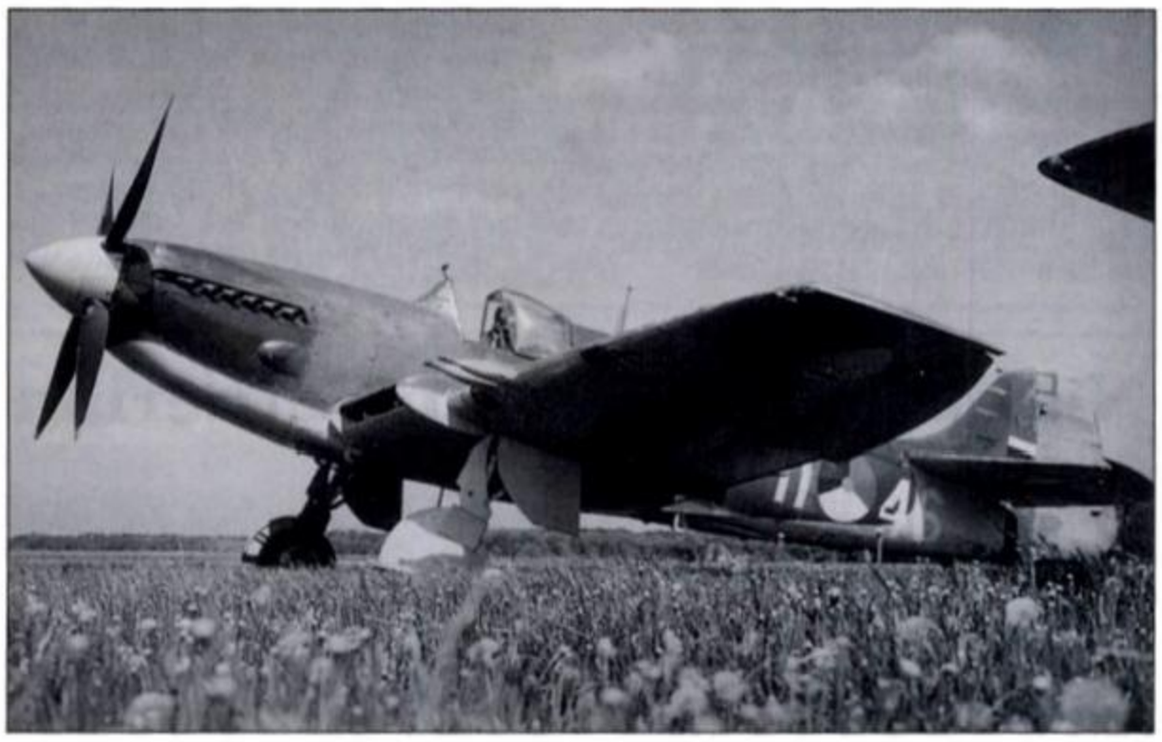
Left: One of the MLD's dual-control Firefly T.Mk 1s, coded '12-12' (from its serial F12), is seen here in the company of other Dutch military types. The last three trainers were withdrawn in 1960.

Above: K34 and K42 were among the first new-build FR.Mk 4s delivered to the MLD in April 1947. The latter was converted to target-tug standard.

The only known application of a shark-mouth to the nose of a Firefly is this example on a RNNAS Mk 4, seen during deployment to Biak, in Dutch New Guinea. Though its cannon have been removed, the aircraft retains rocket rails and bomb racks.

Above: These 10 Mk 4s were pictured in the UK during May 1947, prior to their delivery in the following August.

Below: After a few years of service, K46 was looking a little the worse for wear when photographed at rest on an airstrip in the Netherlands. Nine of the Dutch Fireflies were written-off in accidents, four aboard the RN carriers HMS Theseus *(one) and* Illustrious *(three).*

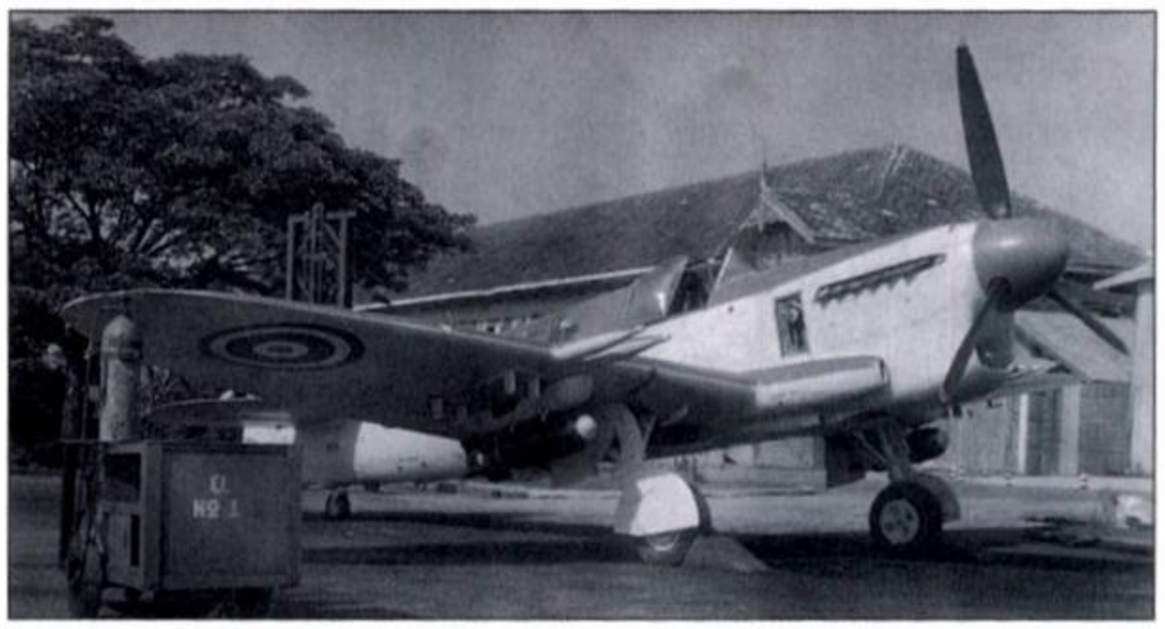


Thailand (Royal Thai Navy/Royal Thai Air Force)

When, in 1949, the Royal Thai Navy was seeking a suitable strike aircraft for its nascent navy, it chose the Firefly and ordered 10 FR.Mk 1s and two T.Mk 2s. Fairey bought the required number of aircraft from surplus RN stocks, and refurbished and converted them during 1951 at Ringway. The aircraft were SF1 (MB469), SF2 (MB445), SF3 (DK483), SF4 (MB407), SF5 (MB494), T.2 SF6 (Z2037), SF7 (DT931), SF8 (MB439), T.2 SF9 (MB750), SF10 (MB435), SF11 (MB410) and SF12 (Z2102).

The Fireflies were crated and taken by sea to Bangkok in 1951; by the time they arrived, the navy had tried to assume control of the country and had abducted the prime minister. The coup was a dismal failure and the officers involved were imprisoned. The Fireflies were transferred to the Royal Thai Air Force base at Don Muang where they were assembled, received new markings and test flown by a Fairey test pilot.

Unfortunately, the Thais had not bought any spares so three aircraft never flew, being cannibalised to keep the others flying. The flyable ones were assigned to No. 1 Squadron of IV Wing, where they were operated until retirement in 1954. Although unconfirmed, it was said that the Fireflies were used operationally against insurgents/terrorists, and photographs exist of some bombed-up examples.



Above: 'Bombed-up' Thai Firefly SF1 is seen here being serviced, possibly prior to a mission against terrorists. The bombs appear to be of the 1,000-lb (454-kg) variety and of US manufacture. The aircraft also carries rocket rails. Delivered to the Royal Navy as MB469 in 1945, SF1 served with No. 1791 Squadron, FAA as an NF.Mk 1 night-fighter and later as an FR.Mk 1 with No. 1830 Squadron, RNVR before being struck off charge and sold to the Royal Thai Navy.

Left: Although the Thai Navy never operated the type, at least one Firefly has been photographed with a naval 'anchor' roundel and white rudder bands displayed. However, all 12 aircraft were eventually finished in the markings depicted here on SF12. One aircraft, SF11, has survived and is displayed in the RTAF Museum, Don Muang Air Base, Bangkok.

Civil operators

Svensk Flygjanst AB

Svensk Flygjanst AB (Swedish Air Services Ltd) was formed in 1935 to provide banner-towing, passenger flights and flying lessons. A contract was signed at the beginning of World War II to provide target-towing and other services to the military. A wide variety of aircraft was acquired, including Miles Martinets for target-towing, but by 1948 they were becoming too slow for this type of work and a replacement was sought. The Firefly TT.Mk 1 just fitted the bill and Svensk acquired 19, although the last three were only used as spares. They were all placed on the Swedish civil register – SE-BRA (DK568), SE-BRB (DK459), SE-BRC (Z1908), SE-BRD (Z2033), SE-BRF (DT986), SE-BRG (DT989), SE-BRH (MB387), SE-BRI (DV121), SE-BRK (MB503), SE-BRL (DT939), SE-BRM (DK430), SE-BYB (MB624), SE-BYC (MB728), SE-BYD (MB702), SE-CAU (PP469), SE-CAW (PP392), SE-CHL (Z1842), SE-CHM (Z1850) and SE-CHN (MB579). The last three were acquired from the RDAF and were used as spares to keep the others flying. They were finished in yellow overall with SVENSK FLYGTJANST AB STOCKHOLM stencilled under the front cockpit area in black. Most continued in the target-towing role until 1964, when the last were retired.

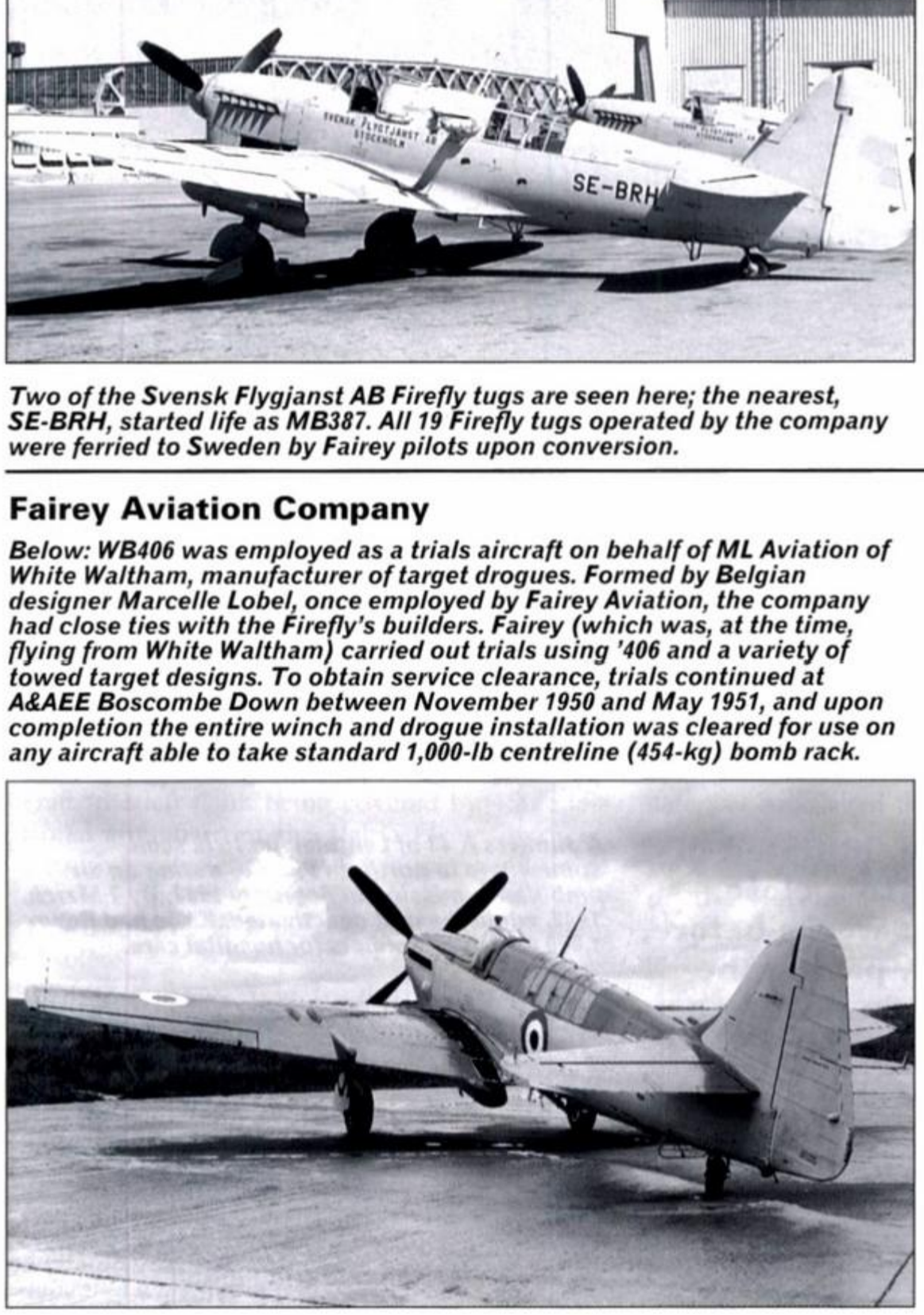
One or two were saved as museum pieces, including SE-BRD, which arrived in the UK in May 1964 to join the Skyfame Museum at Staverton. 'BRD (Z2033) has since joined the Imperial War Museum's collection at Duxford where it is displayed in FAA colours as *Evelyn Tentions*.

Two of the Svensk Flygjanst AB Firefly tugs are seen here; the nearest, SE-BRH, started life as MB387. All 19 Firefly tugs operated by the company were ferried to Sweden by Fairey pilots upon conversion.

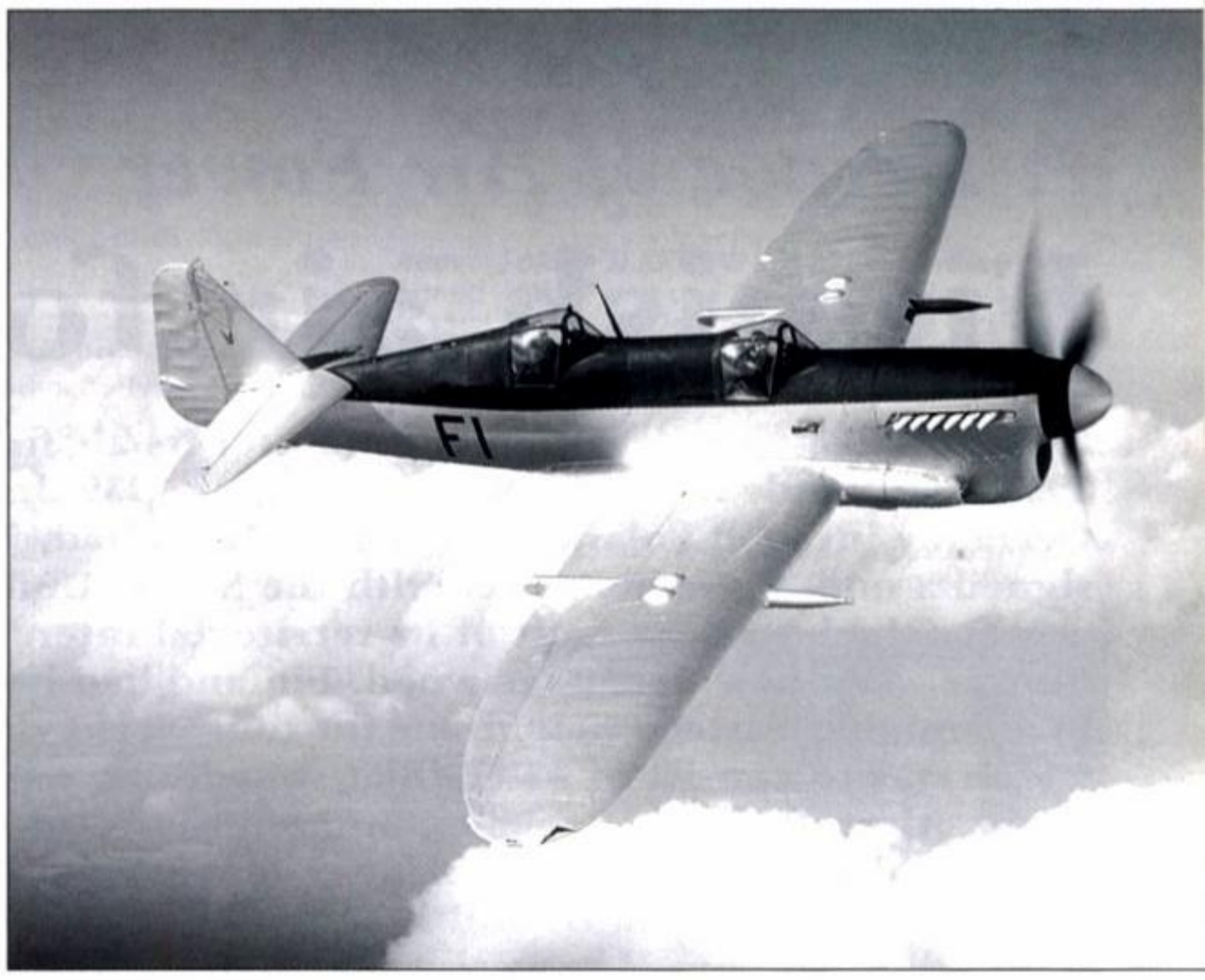
SE-BRA, the first of Svensk Flygjanst's aircraft, was delivered on 8 December 1948, via Holland and Denmark. All up, the fleet flew 14,962 hours. Individual machines had between 1,500 and 3,000 hours on their airframes when retired.

Fairey Aviation Company

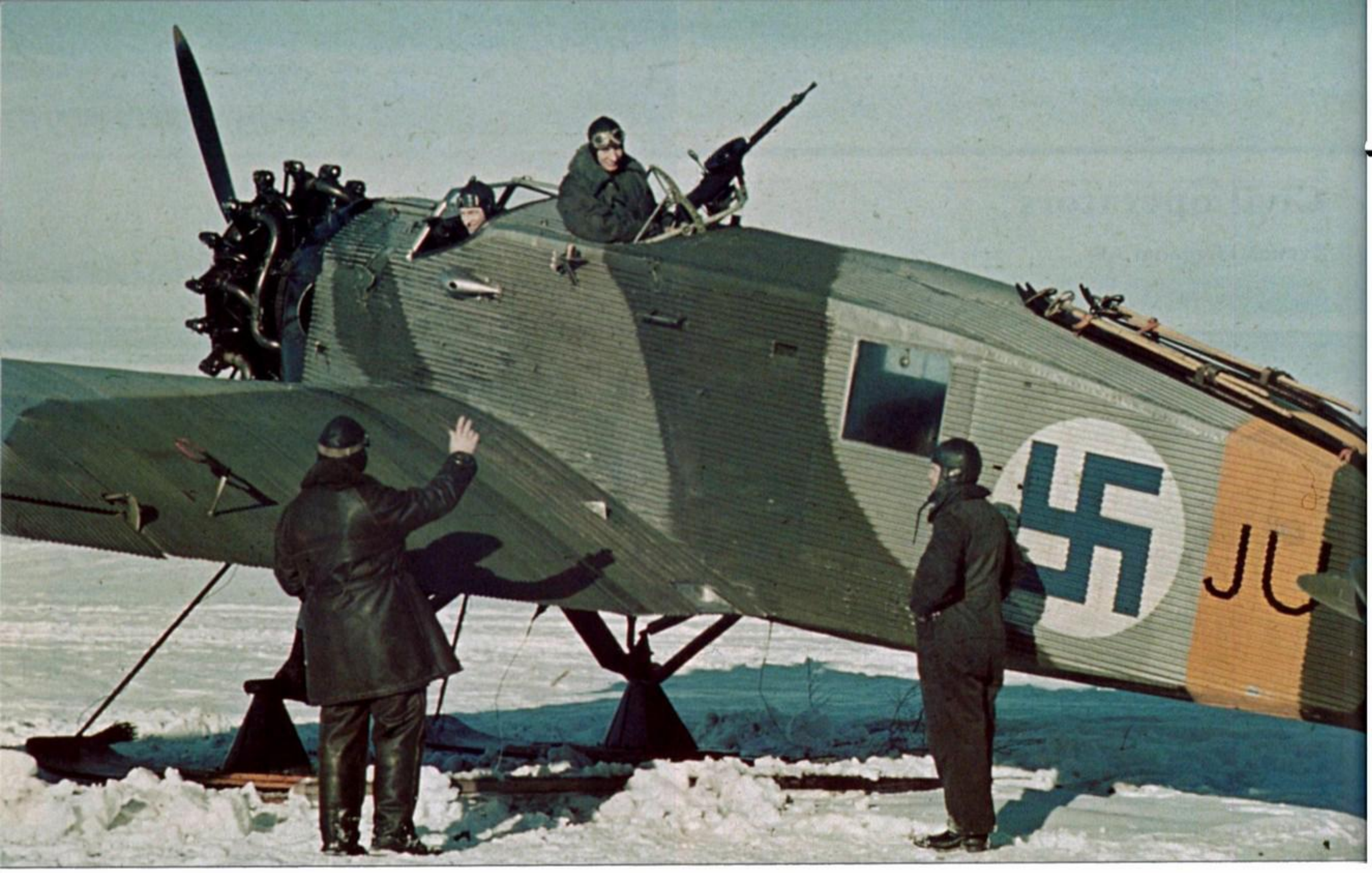
Below: WB406 was employed as a trials aircraft on behalf of ML Aviation of White Waltham, manufacturer of target drogues. Formed by Belgian designer Marcelle Lobel, once employed by Fairey Aviation, the company had close ties with the Firefly's builders. Fairey (which was, at the time, flying from White Waltham) carried out trials using '406 and a variety of towed target designs. To obtain service clearance, trials continued at A&AEE Boscombe Down between November 1950 and May 1951, and upon completion the entire winch and drogue installation was cleared for use on any aircraft able to take standard 1,000-lb centreline (454-kg) bomb rack.



Right: Smartly-finished Firefly Mk 4 TW692 is seen at Heston while being prepared for a demonstration tour to Iraq by Fairey test pilot Group Captain Gordon Slade. A number of countries expressed interest in acquiring Fireflies, only to come up against various obstacles (official and otherwise) to thwart their plans. These included Argentina, which contacted Fairey with a view to purchasing Mk 4s (for cash!), but ran up against objections from the FAA which had yet to receive its own aircraft and could not possibly condone a similar sale to a South American country. Afghanistan also requested 'modern aircraft' from Britain; the Air Staff initially recommended that 20 Mk 4s be supplied, but approval was later withdrawn. France was also very interested in the type, and Fairey sent Mk 4 TW729 and trainer F1 across the English Channel for demonstrations and an appearance at the 1946 Paris Air Salon. However, orders never materialised. In April 1950, Finland was identified as a possible customer, along with Iraq and Egypt, but initial negotiations came to nought. Lebanon got as far as deciding on 24 Mk 5s for its air arm, but negotiations fell through. Saudi Arabia asked for seven Mk 5s, including a trainer; however, the prospect of follow-on orders disturbed the Admiralty and Saudi Arabia was informed that the Firefly would perhaps be unsuitable for service in the Middle East. Syria had a similar experience, Fairey encountering official objections to the release of even Mk 1s.



Above: Fairey's striking company demonstrator F1 (G-AHYA, ex-MB750) made a trip to France on a sales drive with the prospect of a sizeable order, but none was forthcoming.



A Decade of Air Power

Finnish air force 1940-1949

Finland's five-year development plan for its air force, initiated in 1937, was barely half completed when, as 1939 drew to a close, Germany invaded Poland. The Third Reich had, just weeks before, signed a non-aggression pact with the Soviet Union, paving the way for the latter's pursuit of its territorial interests in northern Europe. As a new decade dawned, Finland had been under attack by its mighty eastern neighbour for four weeks. Its new air force, which was to consist of 11 combat squadrons, was nowhere near ready. Aircraft purch... had commenced, but deliveries had only amounted to 34 Fokker C.X army co-operation aircraft, 42 Fokker D.XXI fighters and 18 Bristol Blenheim Mk I bombers by the time war had broken out. It was against this background that the 'David and Goliath' struggle between Finland and Russia unfolded, shaping the history of the *Ilmavoimat* of the 1940s.

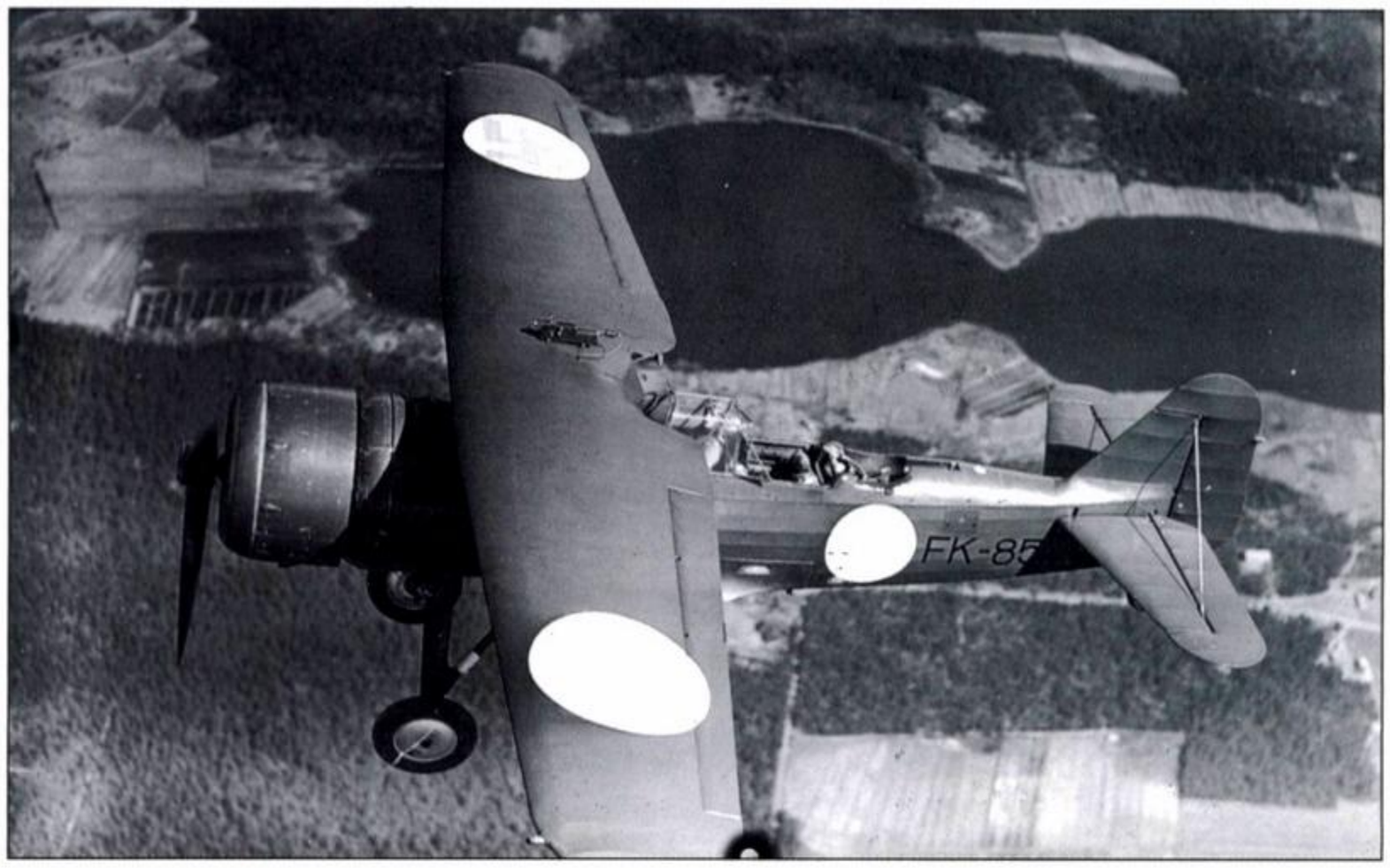
A Junkers K 43 of Lentolaivue 15 is seen somewhere in northern Finland during an air ambulance mission in February 1942. By 7 March 1942, when the unit deactivated, K 43s had flown 1,600 wounded soldiers for hospital care.

As the winds of war swept northern Europe in late 1939, the region's two most powerful states, Germany and the Soviet Union, ominously signed a non-aggression treaty. The Ribbentrop-Molotov Pact of August 1939 included a secret agreement whereby the two states effectively divided eastern and northern Europe between them. Within the Soviet Union's 'sphere of interest' fell the Baltic countries and Finland.

When, on 1 September 1939, Germany invaded Poland and rapidly took the western parts of the country, the Soviet Union occupied eastern Poland and forced Estonia, Latvia and Lithuania to hand over military bases. The following month, Soviet troops and ships of the Red Banner Baltic Fleet were transferred to the southern coast of the Gulf of Finland. Finland had a border some 1,000 miles (1600 km) in length with the Soviet Union and, in the south, a coastline of just 60 miles (96 km) on the Gulf of Finland. Within a couple of weeks, the Finnish military/political situation was to change dramatically.

In October the Soviet Union proposed moving its border with Finland westwards, on the pretext that this was necessary to provide land for bases for the defence of Leningrad if Germany threatened the Soviet Union by attacking via Finland. These proposals were

A pilot with HLeLv 33 boards his Bf 109G, serialled MT-456, at Utti in August 1953. The blue and white roundel was introduced on 1 April 1945, under the terms set down by the Allied Supervision Commission. The Finnish air force operated a varied fleet during the 1940s, originating from at least seven different countries.



This is a Fokker C.X dive-bomber (FK-85) of Lentolaivue 10 in the vicinity of Viipuri on 11 May 1935. Designed in the Netherlands and first flown in 1933, the type was widely used in army co-operation duties during both wars. Most of the Finnish examples were locally built.

Order of Battle, 30 November 1939

UNIT	BASE	AIRCRAFT
Lentorykmentti 1	***Imatra***	
LLv 10	Lappeenranta	12 Fokker C.X
LLv 12	Suur-Merijoki	13 Fokker C.X
LLv 14	Laikko	4 Fokkers C.X and 7 C.V
LLv 16	Värtsilä	8 Ripon and 4 Junkers K.43
Lentorykmentti 2	***Immola***	
LLv 24	Immola	36 Fokker D.XXI
LLv 26	Heinjoki	10 Bulldog
Lentorykmentti 4	***Joroinen***	
LLv 44	Joroinen	8 Blenheim
LLv 46	Luonetjärvi	9 Blenheim
Lentolaivue 36	Vuosaari	6 Ripon

treated by Finland as an attack on its sovereignty; when the government protested, the Soviet Union attacked, on 30 November 1939. The Finnish-Soviet Winter War had begun.

The Winter War

Fearing an invasion, Finland had established a line of defence across the Karelian Isthmus known as the Mannerheim Line (after the commander-in-chief of Finnish forces, Marshall C. G. E. Mannerheim). Initially, Soviet troops attacked along the length of the long border with about 20 divisions supported by 2,800 aircraft, the left flank being covered by 450 additional aircraft from the Baltic Fleet air forces. Finnish ground forces could muster barely nine divisions and for air operations there were only 114 front-line aircraft available, most of them obsolete.

Finnish Fokker fighters of LLv 24 were distributed among several bases and enjoyed notable successes from the beginning, destroying 12 bombers on the second day of fighting and another dozen again on 19 December 1939. Soviet bomber crews grew more wary as fighters were encountered with increasing regularity. The few Blenheim bombers were also employed, but only on long-range reconnaissance missions; these and other units soon shifted to night operations as a means of avoiding contact with the enemy.

By the end of December the Finnish defences had halted the Soviet advance and had caused considerable losses to their ground and air forces. There were now 50 Russian divisions on the Karelian Isthmus – equivalent to a 1,000,000-man army, while the Red air forces increased their sortie rates, flying 1,000 sorties a

Above: Fokker D.XXI (FR-76) of Lentolaivue 24, armed with 20-mm cannon in underwing fairings, is seen at Utti, 16 December 1937. Five victories were scored with the cannon in the Winter War.

The first of 35 Fiat G.50s purchased from Italy is seen at the State Aircraft Factory (Valtion Lentokoneteholas) on 25 January 1940. The serial number SA-1 was changed to FA-1 the next month. Test pilots flew the type successfully on interception missions during the Winter War.

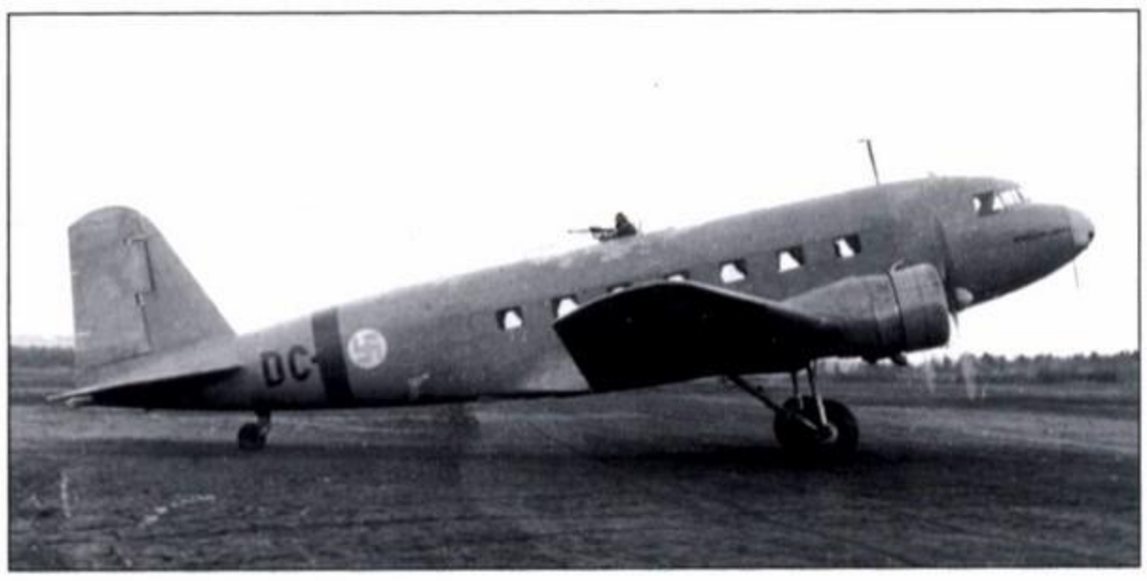
France gifted 80 Caudron-Renault CR.714 fighters to the Finns in 1940. Only six had been shipped by the time the Winter War had ended, arriving in May and receiving the serial numbers CA-551/556. (Another 10 aircraft were in Le Havre when France capitulated; three more were on their way there.) On 3 and 4 September four aircraft of the six delivered were flown under favourable conditions to Pori for use by Lentolaivue 30. On landing, two overshot the runway and were damaged. On 10 September 1940 all were grounded due to their very poor take-off and landing characteristics. By 16 May 1941 all had been withdrawn by the air force. CA-552 is seen after assembly at the State Aircraft Factory located at Tampere in late May 1940.

Right: British pilots flew a second batch of 12 Bristol Blenheim Mk Is to Finland in early 1940, for service with Lentolaivue 42. This one, with civil registration OH-IPD and overpainted insignia, had just arrived at Juva on 26 February. An aircraft from RAF stocks, it became BL-137.

A Decade of Air Power

Right: Six Gloster Gladiator Mk Is of the Swedish voluntary unit Flygflottilj 19 flew back to Sweden after the Winter War via Kauhava, where they lined up on 30 March 1940 before departure. A letter on the rudder identified each aircraft and the skulls and crossbones were applied after the hostilities.

Below: State Aircraft Factory-built Fokker C.X dive-bomber FK-90 of Lentolaivue 10 is seen here after being serviced at Luonetjärvi on 7 March 1940. A blow torch connected to the canvas bag around the engine cowling was used to warm the powerplant prior to starting.



Douglas DC-2 Hanssin-Jukka (serialled DC-1) of Lentolaivue 46 is seen here at Luonetjärvi in September 1941. The aircraft arrived from Sweden in 1940 and after one bombing mission with LLv 44 was employed to fly fuel to the army's armoured units during the Finnish advance in 1941. It later served in photo-mapping and staff transport roles.

Above: Gloster Gladiator Mk II GL-274 of Lentolaivue 14 is seen at Utti on 11 July 1940. During the Winter War, Lentolaivue 26 scored 34 aerial victories with these aircraft.

day over the front on several occasions. However, the effectiveness of these bombing sorties on Finnish ground forces was negligible.

Slowly, foreign assistance – mostly from Britain and France – began to reach Finland. In late January, Lentolaivue 46 handed over its Blenheim Mk Is to Lentolaivue 44 and re-equipped with 12 new Blenheim Mk IVs. Lentolaivue 26 exchanged its obsolete Bulldogs for 30 Gloster Gladiators from late January and again re-equipped with 35 Fiat G.50s in March. In February the newly established Lentolaivue 28 received 30 Morane-Saulniers MS.406s.

Left: Practically the entire Finnish air force was thrown into action in an attempt to stop Russian forces crossing the ice-covered Gulf of Viipuri to the rear of the Finnish defensive lines. This Blenheim Mk IV, serialled BL-129, flew with Lentolaivue 46 at this time and is seen here being refuelled at Luonetjärvi on 7 March 1940.

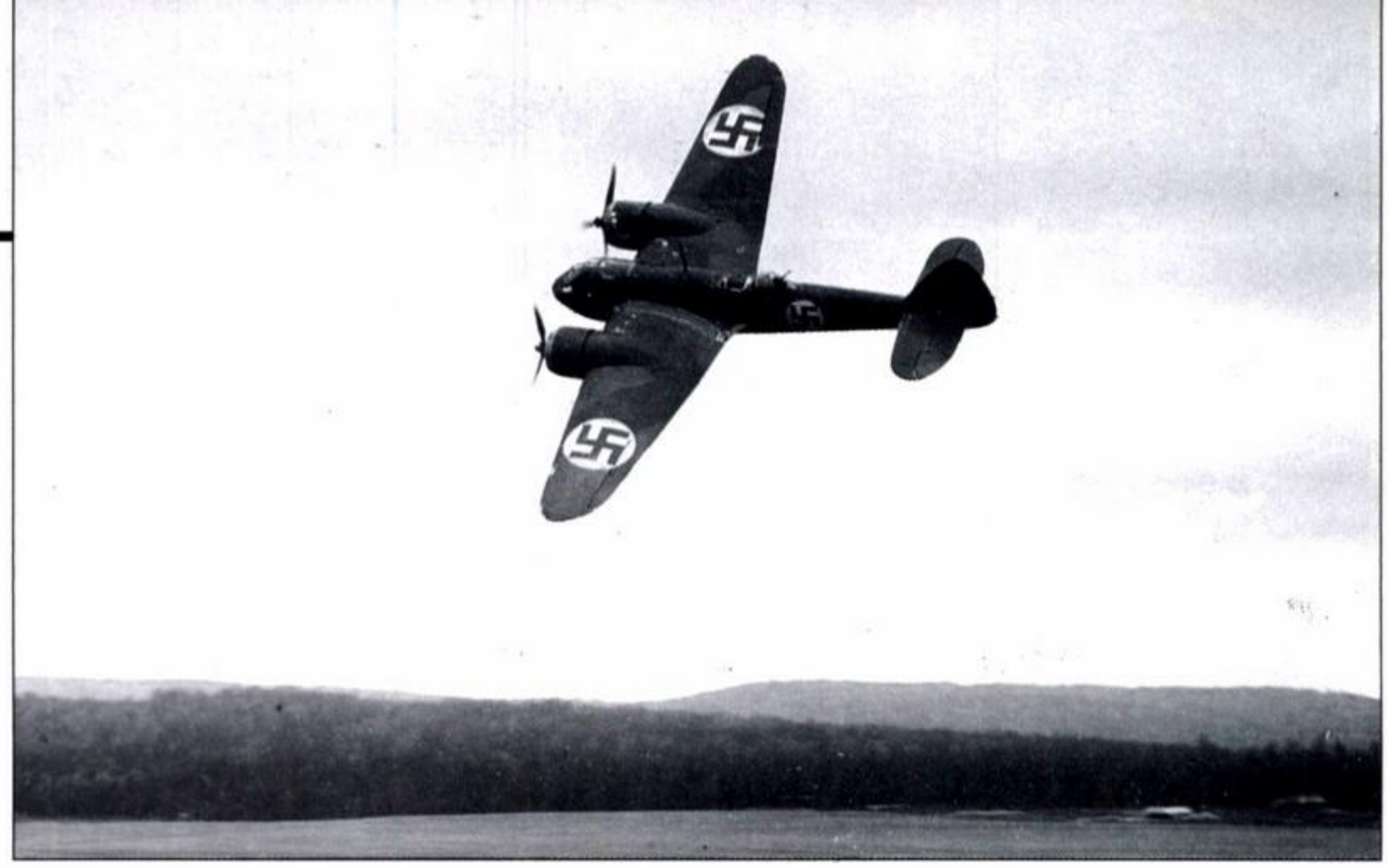
Twelve Blenheim Mk Is arrived for the recently established Lentolaivue 42, replacing losses and helping to build up front-line strength to 130 aircraft. Most of the new equipment was superior to the Soviets' Polikarpov I-153 and I-16 fighters, Tupolev SB and Ilyushin DB-3 bombers and Polikarpov R-5 reconnaissance machines.

Full-strength bomber force

This new equipment allowed the Finnish bomber force to switch from carrying out sorties with single aircraft to concentrated squadron attacks. More fighters were available to defend lines of communication and supply in the rear. On 6 January 1940 Lentolaivue 24 pilot Lt Jorma Sarvanto, flying a Fokker D.XXI, shot down six Soviet DB-3 bombers of 6 DBAP in four minutes, while returning from a mission over central Finland; the event attracted world-wide attention.

A Swedish volunteer unit, F 19, arrived in Lapland on 10 January to assist in the defence against Soviet bombing. This unit had 12 Gloster Gladiator fighters and four Hawker Hart light bombers. The Gladiators were widely

The first captured Ilyushin DB-3M was delivered to Lentolaivue 36, and is seen here parked in a hangar at Helsinki-Malmi on 3 March 1940. Its original Finnish serial, VP-101, was changed to VP-11 the following December.



This Lentolaivue 42 Blenheim Mk I (BL-136) banks for the photographer situated in the control tower at Luonetjärvi in August 1940. Its starboard aileron has evidently been replaced at some point, and is probably finished in standard British camouflage.

deployed to give the Soviets the impression that there was a large fighter force in the area, and soon the attacks stopped.

The second phase of the offensive was initiated by the Russians on the Karelian Isthmus front on 11 February, leading to a breakthrough, but by the end of the month the Finns had stabilised the front between Viipuri (Vyborg) and Lake Ladoga, and managed to maintain these positions until the end of the hostilities. Soviet losses continued to mount, but on 29 February the 24 fighters of 68 IAP managed to surprise the Gladiators of LLv 26 taking off at Ruokolahti air base, shooting down three immediately and two more in the ensuing combat.

Soviets cross Gulf of Finland

On 4 March the Soviet army crossed the ice of the Gulf of Finland west of Viipuri and formed a small bridgehead on land in the Finnish rear. All Finnish flying units were to undertake ground attack missions against these troops and supply convoys. During the ensuing six days all three regiments flew 350 bombing and strafing sorties, sweeping the ice of troops who had not found cover. The Gulf of Viipuri also drew the attention of Russian fighters, which shot down three Blenheims and one Fokker D.XXI. Finnish interceptors downed five fighters, and gunners in other aircraft claimed another three.

Political pressure from Britain and France, and the unexpectedly robust opposition of the Finnish forces, persuaded the Soviet Union, which had achieved some of its military goals, to agree to a truce. This was signed on 13 March 1940, but forced Finland to hand over a considerable area of land. The Winter War had lasted 105 days and during this period the Finnish air force had shot down 207 Russian aircraft for the loss of 48 of its own aircraft on operations. Finnish aircraft flew 5,963 sorties, a fraction of the huge number flown by the Red air forces – 100,970.

Right: A VL (Valtion Lentokonetehdas) Pyry advanced trainer gleams in the sun on the first snow of the 1941/42 winter at the Lentosotakoulu base at Kauhava, 22 October 1941. Forty-one production aircraft (known as Pyry Mk IIs) were built by VL during the first half of 1941. A Pyry Mk I prototype first flew in 1939.

Uneasy peace

Many of the aircraft ordered during the Winter War arrived too late to take part in the conflict, including a dozen of both the Westland Lysander and Hawker Hurricane, plus

Ski trials were carried out at the State Aircraft Factory at Tampere in April 1940, using Brewster Model 239 BW-370. These fixed skis were unique; the following winter, retractable skis proved far more successful.

Morane Saulnier MS.406 MS311 was also fitted with fixed skis at the factory and trialled at Tampere in April 1940. Neither these nor a retractable design developed for the MS.406 proceeded beyond the experimental stage.

Twelve Hurricane Mk Is arrived from Britain, but did not see action in the Winter War. HU460 of Lentolaivue 22 is parked outside the hangars at Helsinki Malmi 6 April 1940. The 'HU' serial prefix was changed to 'HC' in May.

Finnish air force chronology 1940-1949

1939

30 November The Soviet Union attacked Finland and the Winter War began. The Finnish air force had 111 serviceable aircraft at its disposal, compared to 3,253 Soviet aircraft on the Finnish front.

8 December A third squadron was added to fighter regiment Lentorykmentti 2 when Lentolaivue 28 was established, the unit receiving Morane Saulnier MS.406 fighters the following February.

1940

1 January Finnish defences had halted the Soviet advance. Front-line strength was 109 serviceable aircraft.

10 January Swedish volunteer unit Flygflottilj 19 arrived at Kemi, northern Finland, to defend Lapland with 12 Gladiators and 4 Harts. LLv 22 was established within Lentorykmentti 2, to be equipped with Hurricanes and Brewster 239s in March.

16 January LLv 42 was established as the third squadron in bomber regiment Lentorykmentti 4. Twelve ex-RAF Blenheim Mk Is arrived six weeks later.

11 February The major Soviet land attack commenced on the Karelian Isthmus; its advance was stopped outside Viipuri by the end of the month.

13 March The Winter War ended and Finland, though unconquered, was forced, by the Moscow peace treaty signed on 12 March, to hand over land in the southeast.

27 March Lentorykmentti 1 and one of its squadrons, LeLv 10, were disbanded. The other three squadrons within the regiment, LeLv 12, 14 and 16, became autonomous. The second fighter regiment, Lentorykmentti 3, was formed with three squadrons, LeLv 32 (formerly LeLv22) with Fokker D.XXIs and LeLv 30 and 34 with advanced trainers. Maritime unit LeLv 36 was renumbered LeLv 6, so as not to be confused with the squadrons of Lentorykmentti 3.

30 March Flygflottilj 19 returned to Sweden having flown 464 sorties and claimed eight air-to-air kills.

30 September New camouflage schemes were introduced on most types within the Finnish air force.

1 October The German authorities agreed to supply captured materiel to Finland. In return Finland allowed the transit of German troops to northern Norway.

Bristol Mercury radial-powered Fokker D.XXIs (FR-108 and FR-90) of Lentolaivue 32 are seen parked at Utti on 9 July 1941. Within a week the squadron would exchange its Fokkers for the Curtiss Hawks flown by Lentolaivue 14 and Lentolaivue 16 in the army co-operation role.

Order of Battle, 25 June 1941

UNIT	BASE	AIRCRAFT
Lentorykmentti 2	***Pieksämäki***	
LeLv 24	Vesivehmaa	33 Brewster
LeLv 26	Joroinen	26 Fiat G.50
LeLv 28	Naarajärvi	27 Morane 406
Lentorykmentti 3	***Pori***	
LeLv 30	Pori	5 Hurricane and 18 Fokker D.XXI
LeLv 32	Hyvinkää	12 Fokker D.XXI
Lentorykmentti 4	***Luonetjärvi***	
LeLv 42	Siikakangas	9 Blenheim
LeLv 44	Siikakangas	8 Blenheim
LeLv 46	Luonetjärvi	3 Blenheim and 4 DB-3M
Lentolaivue 6	Turku	2 Koolhoven F.K.52, 3 SB-2 and 5 I-153
Lentolaivue 12	Mikkeli	3 Gladiator and 7 Fokker C.X
Lentolaivue 14	Padasjoki	4 Gladiator and 6 Fokker C.X
Lentolaivue 16	Rissala	6 Gladiator, 3 Lysander and 4 Fokker C.X

Left: This Brewster Model 239, serialled BW-372, served with Lentolaivue 24 at the time of this photograph, taken on a sandy lakeside beach near Joensuu in late July 1941. Forty-four examples were bought from the USA in 1939, but arrived too late to participate in the Winter War.

Left: A single Polikarpov I-16UTI trainer was captured in 1941. Serialled UT-1, it was used for familiarisation flights for just four months before going into storage. It is seen here while with Täydennyslentolaivue 35 at Vesivehmaa in August 1942, shortly before being grounded.

44 Brewster Model 239s (F2A-1 Buffaloes), which were to play a major role in the future.

Germany invaded Denmark and Norway in April 1940, isolating Finland from the west and leaving it sandwiched between Germany and Russia. Given the harsh terms of the Moscow peace treaty, Finland tentatively sought help from Germany. However, Hitler elected to remain neutral, at least for the time being.

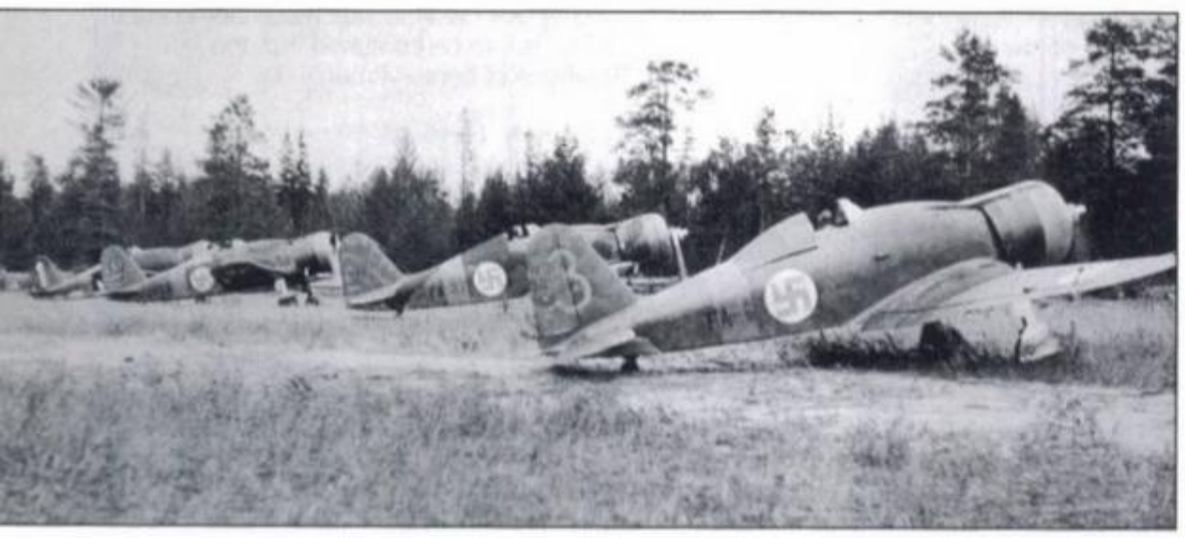
In June, Germany occupied Belgium, Holland and France, while the Soviet Union annexed Estonia, Latvia and Lithuania in August. Finland became even more isolated. From the autumn, Germany began planning an invasion of Russia. In preparation, the Third Reich gathered friendly nations to its side, in the process offering Finland war materiel captured from the states that it had occupied. Of course, the Finns were unaware of Germany's intentions towards the Soviet Union.

Meanwhile, in late 1940 the air force received 10 Morane Saulnier MS.406s, followed by a further 10 and 16 Curtiss Hawk 75As six months later. The State Aircraft

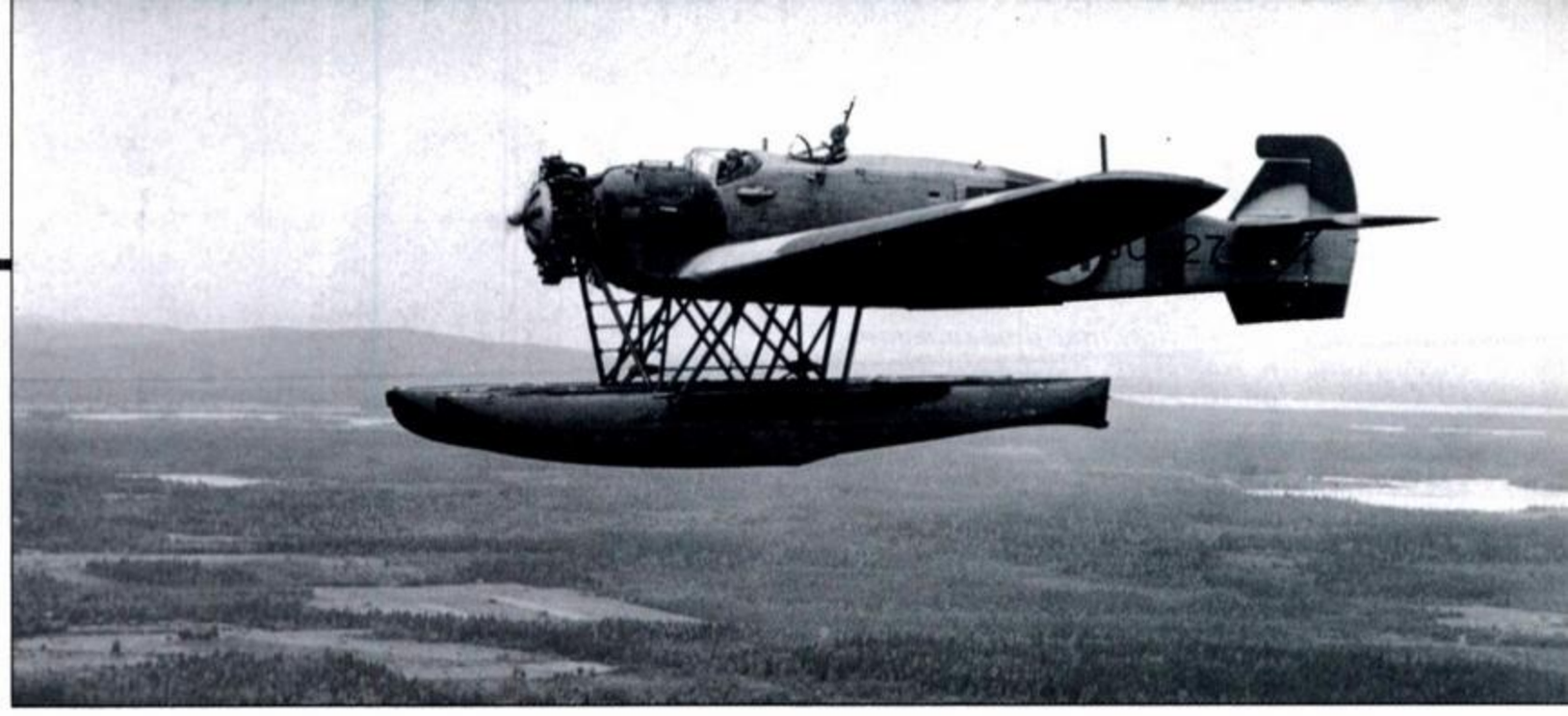
Left: Lentolaivue 16 carried out reconnaissance for the Karelian Army with Gloster Gladiators. Here aircraft of the 1st Flight sit on the dry sandy shore of Lake Höytiäinen near Joensuu on 1 July 1941, ready for their next sortie. The nearest aircraft is GL-265.

Below: At the beginning of the Continuation War Lentolaivue 28 was stationed at Naarajärvi. Morane-Saulnier MS.406s of the 3rd Flight are seen here at readiness at the base on 28 June 1941. The serial numbers of MS-603, MS-318 and MS-325 may be discerned. The unsatisfactory retractable oil cooler was a prominent feature of the MS.406. Finnish Morane pilots claimed 135 aircraft shot down during the Continuation War.

Below: These Fiat G.50s of Lentolaivue 26 have just returned from a mission to Lunkula on the dry shore of Lake Ladoga on 4 September 1941. From left, the aircraft are FA-3, FA-35, FA-27 and FA-6. Their tail markings represent the squadron's three flights.



Above: On 9 July 1941, the war correspondents driving this car ventured a little too far out on to the airfield at Utti and into the path of taxiing Fokker D.XXI FR-116 of Lentolaivue 32.



Above: Junkers K.43 ambulance JU-127 of LLv 15 is seen over eastern Karelia in September 1941. Inbound flights to the front-line often carried partisans to drop points behind the lines.

Below: A pair of Wasp Junior-powered Fokker D.XXIs of Lentolaivue 30 scramble from Hyvinkää on 9 July 1941. FR-155 and FR-119 belonged to the 2nd Flight, tasked with the defence of Helsinki.

Factory commenced licensed production of 50 Fokker D.XXIs (the licence being obtained in 1938) in the first half of 1941. The shortage of Mercury engines necessitated the use of Pratt & Whitney R-1535 Twin Wasp Juniors.

Finland was unaware of German plans to invade Russia (Operation Barbarossa) until almost the last minute. The attack began on 22 June 1941 and three days later the Red air forces bombed several targets in Finland, considered to be in a state of war with Russia. Finland thus became a comrade-in-arms with Germany, although there were no political, commercial or industrial ties with The Third Reich – they merely had a common enemy.

The Continuation War

Finland was, by now, much better equipped than during the Winter War. There were two fighter regiments with a total of five squadrons, all practically at full strength. The bomber regiment possessed the necessary strike capacity and the army co-operation squadrons were properly equipped for their role. The 15 months of peace had been used for training, servicing equipment and upgrading the organisation to better defend the country.

The Russian air forces had about 500 aircraft on the Finnish front. On the first day of the new conflict about 150 unescorted Soviet bombers appeared over southern Finland with the aim of decimating air defences. Fighters scrambled and shot down 26 of the attackers without loss. Fiats of LeLv 26 scored 13 and Brewsters of LeLv 24 another 10 victories. The air raids against airfields continued for a week, though their effect was minimal.

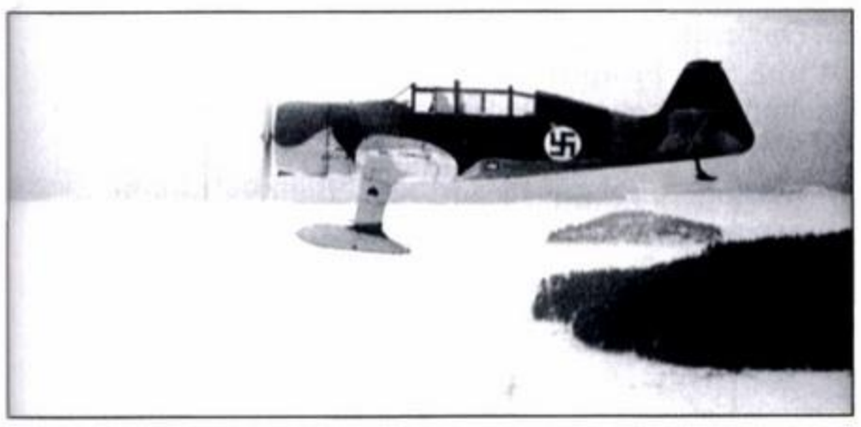
Finland's army joined the offensive against

Above: This Dutch-built Koolhoven FK.52 army co-operation aircraft (KO-130) of Lentolaivue 6 was based at Turku in May 1941. Two aircraft were acquired in 1940 with Swedish funding, and flew coastal reconnaissance missions in both the Winter and Continuation Wars.

This Pyry II advanced trainer (PY-4) of Täydennyslentolaivue 35 was photographed from a sister aircraft during an exercise flight from Vesivehmaa on 15 December 1941. The unit flew a variety of obsolete fighters such as Bulldogs, Gauntlets and a captured Polikarpov I-15bis.

Avro Anson Mk I AN-102 served as a bomber crew trainer with Lentolaivue 42 at Luonetjärvi in July 1941. Three were bought from the UK in 1936. Although a new machine, it was allotted the RAF serial K8739 at the factory.

Hurricane Mk I HC-451 of Lentolaivue 32 has its Merlin run up during testing after an overhaul at Immola on 21 October 1941. A lack of spares kept the Hurricanes largely grounded.



1941

1 March Ilmasotakoulu, the Finnish air force's air fighting school, was renamed Lentosotakoulu, the 'flying fighting school'.

25 May Finnish military leaders were officially informed about Operation Barbarossa, the German invasion to Soviet Union.

17 June Full-scale mobilisation of the Finnish forces began, with a view to joining the German attack on the Soviet Union. All Finnish aircraft were painted in the yellow Axis eastern front markings.

25 June Soviet bombers attacked Finnish cities and towns. Finland declares war and the Continuation War began.

27 June Täydennyslentolaivue 35 was established for advanced training; The State Aircraft Factory completed a batch of 40 Pyry advanced trainers and 50 Wasp-powered Fokker D.XXI fighters.

30 June Lentolaivue 15 was established for ambulance duties.

2 July The Karelian Army was formed with the aim of recovering the territory lost to the Soviet Union in and after the Winter War. Air force regiment Lentorykmentti 2 and squadrons Lentolaivue 12 and 16 were subordinated to the Army to provide support.

15 July Lentolaivue 46 was declared non-operational, having lost most of its aircraft in combat.

27 July Lentolaivue 34 was merged with Täydennyslentolaivue 35 as part of an advanced training programme.

12 August Lentolaivue 10 was formed at Tiiksjärvi to operate over the eastern Karelian region.

16 September Lentolaivue 26 became part of Lentorykmentti 3 operating on the Karelian Isthmus.

1 October Lentolaivue 25 was merged into Täydennyslentolaivue 35. All advanced training was now concentrated in one unit.

26 October Lentolaivue 10 was disbanded at Tiiksjärvi. Lentolaivue 14, which had supported the Karelian Isthmus occupation, was transferred to eastern Karelia.

1 November Täydennyslentolaivue 17 was disbanded at Luonetjärvi and Lentolaivue 46 took over its training programme.

23 November Lentolaivue 48 was established as part of Lentorykmentti 4, and equipped with captured Soviet bombers.

A Decade of Air Power

Right: Lentolaivue 6 flew maritime missions throughout the war. Here, Blackburn Ripon Mk IIF RI-157 of the 4th Flight is stuck fast in the first ice of the season, on 3 December 1942 at Maarianhamina, Aaland Island. The other three LeLv 6 flights flew a mixture of Dornier Do 22Ks, captured Tupolev SBs and Polikarpov I-153s and Høver MF.11s. After the Soviet invasion of late 1939, Ripons were engaged in photo-reconnaissance tasks for the army. Vulnerable to attack by enemy fighters, these sorties were switched to night time.

Westland Lysander Mk Is were used by Lentolaivue 16 for harassment bombing and reconnaissance. In this wintry, almost festive scene, LY-119 of the 2nd Flight is tucked between the Karelian houses of Viiksjärvi village on 17 February 1942. On the hill to the left is a small Orthodox temple.

the Soviet Union, which was carried out in three waves. On 10 July Finnish Karelian Army troops started the advance north of Lake Ladoga. It was followed three weeks later by an attack to the Karelian Isthmus, and finally, on 4 September 1941, the Karelian Army began the advance towards the River Svir, reaching it in four days. Simultaneously, the German forces arrived on the outskirts of Leningrad, where they would remain for 900 days.

Reconnaissance for the Karelian Army was carried out by Lentolaivue 12 and Lentolaivue 16. The former had recently re-equipped with Curtiss Hawk 75As, but no sooner had it worked up on the type than it was ordered, on 16 July, to trade its machines for those of Lentolaivue 32, then flying Fokker D.XXIs. Another Hawk 75A unit, Lentolaivue 14, was similarly required to exchange its aircraft for Lentolaivue 32's D.XXIs. Useful fighters, like the Hawk 75As, were potentially too valuable to be 'wasted' on reconnaissance units. Only Lentolaivue 16 was able to hold on to its machines, being equipped with Gladiators.

Above: Fokker C.X army co-operation aircraft FK-99 of Lentolaivue 12 is seen parked at Nurmoila on 2 August 1942. A total of 39 was obtained; all but four were built under licence.

Below: Fokker C.X FK-109, part of the third build prepares for a photographic mission from the ice of a frozen lake at Viiksjärvi on 27 March 1942. The 3rd Flight of Lentolaivue 16 used the type throughout the Continuation War. Other duties included leaflet dropping and light bombing.

On the outskirts of Leningrad

In spite of German pressure, Commander-in-Chief Mannerheim halted the Finnish attack at the outer defences of Leningrad, choosing instead to continue further north, where favourable defensive positions were reached by 6 December, between Lake Onega and the White Sea. From then on, the combatants were locked in a stationary war of attrition, which would last two and a half years.

During this Finnish advance, fighters fought numerous air battles. The Karelian Army troop concentrations were monitored by Soviet intelligence and, before long, large formations were sent to attack the Finns. On 8 and 9 July, Brewster 239s of Lentolaivue 24 destroyed 16 Russian aircraft and, together with other fighter units, soon gained aerial supremacy over the front. Blenheims of Lentolaivue 42 successfully harassed the Soviet transport systems. In August, on the Karelian Isthmus, Lentolaivue 44 Blenheims made repeated attacks on Russian air bases, causing serious damage.

12 August was a successful day for the

This ex-Norwegian navy Heinkel He 115A-2 was interned in June 1940, overhauled and handed over to Lentolaivue 15. In September 1941 it was converted to a transport and assigned to Lentolaivue 46, and is here moored on Lake Höytiäinen near Joensuu in July 1942. Appropriately serialled HE-115, the aircraft was engaged in flying up to eight guerrillas at a time behind the lines in the Maaselkä Isthmus region.

Morane-Saulnier MS.406 MS-325 of Lentolaivue 28 is about to take off at Viitana on 17 March 1942. Thirty Moranes were received in 1940 as a gift and another 57 obtained from German and Free French stocks.

Brewster forces. Model 239s of Lentolaivue 24 shot down nine I-153s during a single mission, Fiats of Lentolaivue 26 doing the same on the following day. On 3 September 1941 Fiats scored five kills and Curtiss Hawks of Lentolaivue 32 flew the last combat over the advancing troops on the Karelian Isthmus, claiming seven fighters destroyed. Six days later the Moranes of Lentolaivue 28 downed another seven fighters over the River Svir.

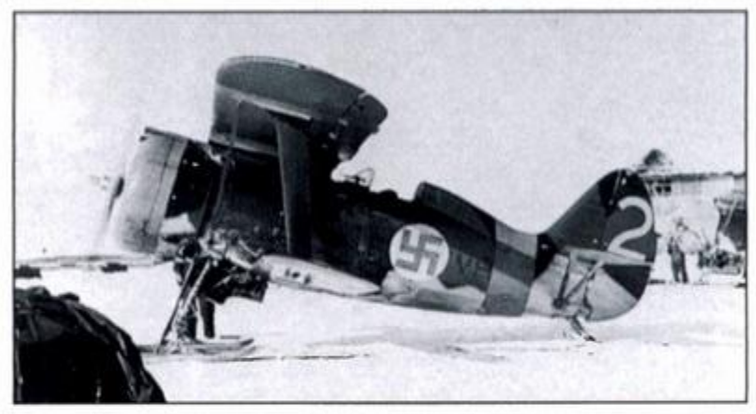
Brewsters were again in action later in the month, shooting down seven fighters on 23 September and another nine aircraft three days later, all east of Lake Onega. Thereafter, many encounters were recorded, but no major combats took place. Blenheim bombers continued to harass the Kirov (Leningrad-Murmansk) railway and were assisted by the cannon-armed Moranes in the 'train busting' role.

During the first six months of the hostilities, the fighter pilots and rear gunners shot down 360 Soviet aircraft, while Finnish losses on operations totalled just 54 aircraft. The Brewster had the best victory-to-loss ratio, with 135 confirmed kills for no losses in combat.

Stationary war

At the beginning of 1942 Finnish front-line strength stood at 110 serviceable aircraft, attrition having been covered by aircraft captured by the Finns themselves (I-153s, SBs and DB-3s), German war booty (MS.406s and Hawk 75As) and local licensed production of 15 Blenheim Mk IIs. The first of 15 Dornier Do 17Z bombers arrived in Finland in early January. The then-disbanded Lentolaivue 46 was re-established and equipped with these ex-Luftwaffe machines – a donation from Reichsmarschall Hermann Göring.

In late March, the Finns went on the offensive, assembling a detachment of 60 aircraft to support the occupation of the strategically important island of Suursaari (Gogland) in the middle of the Gulf of Finland. The landings took place on 28 March. While flying top cover for ground forces, 12 Curtiss Hawks of Lentolaivue 32 shot down 15 fighters out of a Russian fighter formation of 29 aircraft.



Right: This captured Polikarpov I-153 fighter (VH-12, later IT-12) was one of 21 put into Finnish service. Damaged when acquired by the Finns, VH-12 was repaired and served with Lentolaivue 6. Here it is being run up prior to a mission to Suursaari in late March 1942, from a temporary base on the ice outside Kotka.

Right: Brewster Model 239 BW-356 of Lentolaivue 24 receives attention at Tiiksjärvi in September 1942. These machines, largely spurned by the Allies, flew very successfully against the Soviets' Lend-Lease aircraft arriving at the front from Murmansk. Their pilots claimed 33 Hurricanes shot down over a three-month period. The Model 239 was equivalent to the US Navy's F2A-1

Parked under the trees at Nurmoila in Olonets in early July 1942 is ex-French Curtiss Hawk 75A-3 CU-571 of Lentolaivue 32. In the space of six months Hawks shot down, without loss, 65 Soviet aircraft on the Olonets Isthmus; total victories during the war reached 190.

One of the two ex-Swedish Bristol Bulldog Mk IIAs (BU-216) which served as advanced trainers at Täydennyslentolaivue 35 based at Vesivehmaa, is seen here in May 1942. The standard Finnish Bulldog variant was the Mk IVA, of which 17 examples were delivered.

The first Finnish Fiat G.50 is seen here at Immola in December 1942, after repairs following a landing accident in June. It was next issued to Lentolaivue 26 at Kilpasilta. Fiat pilots scored 101 aerial victories in all. The surviving G.50s were retired from front-line duties in 1944.

1942

8 March Lentolaivue 15 was disbanded as the stationary nature of the war reduced the need for the ambulance unit.

5 April Lentolaivue 46 was declared operational, flying Do 17Z bombers.

3 May The Finnish air force was reorganised and regiments given territorial responsibility. The new Lentorykmentti 1 (LeLv 12 and 32) was allotted the Olonets Isthmus, Lentorykmentti 2 (LeLv 16, 24 and 28) remained in the Lake Onega sector, Lentorykmentti 3 (LeLv 26 and 30) on the Karelian Isthmus, and Lentorykmentti 4 (LeLv 42, 44, 46 and 48) flew bombing sorties where required.

18 July LeLv 24 transferred to Lentorykmentti 3 on the Karelian Isthmus.

27 July Lentolaivue 14 in south Viena started conversion to MS.406 fighters, 30 being obtained from German war booty depots in 1942.

5 November Lentorykmentti 5 was established to carry out maritime work and was subordinated to the naval forces. Its squadrons were Lentolaivue 6 with captured Tupolev SBs and a few obsolete floatplanes, and Lentolaivue 30 with Fokker D.XXIs and captured Polikarpov I-153s.

15 December Täydennyslentolaivue 17 was re-established as an advanced training squadron within Lentorykmentti 4.

Left: Blenheim Mk I BL-115 of Lentolaivue 44 cruises over Joensuu on the return leg of a raid on Segesha air base, 24 November 1942. Three months later the squadron would hand the Blenheims over to sister unit Lentolaivue 42 and re-equip with Junkers Ju 88s.

Above: On 11 November 1941 Hermann Göring donated 15 Dornier Do 17Z bombers and 300 tonnes of bombs to the Finnish forces. Lentolaivue 46's DN-57 sits on the shore of Lake Pyhäselkä near Joensuu in July 1942.

PE-212 was a Petlyakov Pe-2 captured and placed in service with Lentolaivue 48. It is seen here in a forest setting at Onttola on 4 September 1942. LeLv 48's 1st Flight spent a full year familiarising itself with the type, due to the total lack of manuals for the aircraft. PE-212 went missing on a reconnaissance sortie in February 1943. Of the seven Pe-2s and one Pe-3 obtained from Germany, only a single Pe-2 survived the war.

The only remaining Blenhem Mk IV, BL-129, of the 12 aircraft flown to Finland in January 1940, served with Lentolaivue 44 when photographed at Onttola in April 1942. The retractable ski design seen here was commonly employed on the Finnish Blenheims.

The Soviet Union had started to receive Lend-Lease aircraft during the previous December, via Murmansk, and the flow of new aircraft continued rapidly via Kantalahti southwards to Leningrad. A Brewster flight of Lentolaivue 24 was sent to Tiiksjärvi in southern Viena to attempt to stem this flow. The outfit subsequently fought many successful air battles, downing eight Hurricanes on 30 March 1942 and another 12 aircraft a week later, including a bomber. During the second week of April, the Soviets attempted to break through the Finnish lines on the River Svir, but were thrown back. The Finns' bomber regiment supported the counter-attack with night missions, though on 15 April luck deserted them as three Blenheims exploded above the target after securing pins on their bombs failed.

Anti-submarine pilots were also thrown into action as the Red Banner Baltic Fleet submarines sailed from Kronstadt to attack Axis shipping in the Baltic Sea. On 28 May the first contact was made, and one patrolling Lentolaivue 6 SB bomber sank submarine M-95 with a 200-kg (440-lb) depth charge.

Reorganisation

On 3 May 1942 the air force was reorganised. Air force regiments were given territorial responsibility from the White Sea to the Gulf of Finland. Lentorykmentti 1 covered the Olonets Isthmus with two squadrons: LeLv 32 flying Curtiss Hawk 75A fighters and LeLv 12 using Fokker D.XXIs and Fokker C.Xs for reconnaissance and army co-operation missions. Lentorykmentti 2 took charge of the Lake Onega sector with three squadrons: LeLv 24 with Brewsters, LeLv 28 equipped with Morane MS.406 fighters (30 more were bought from Vichy France) and LeLv 16 with Gladiators. Lysanders and Fokker C.Xs were employed for tactical reconnaissance and co-operation duties. Lentorykmentti 3 was on the Karelian Isthmus with two fighter squadrons, LeLv 26 having Fiat G.50s and LeLv 30 equipped with Wasp-powered Fokker D.XXIs.

The bomber regiment, Lentorykmentti 4, was deployed where needed. LeLv 42 and LeLv 44 had Blenheims, LeLv 46 flew Dornier

Curtiss Hawk 75As of Lentolaivue 32 scramble from Nurmoila on 16 October 1943. The aircraft closest to the camera is CU-577, one of six ex-French Hawk 75A-1s. Twenty-nine were obtained from Germany in 1941 and another 15 followed in 1943. All were ex-French and ex-Norwegian machines.

Twenty-four Gloster Gauntlet Mk IIs were bought and donated by the Federation of South Africa in 1939. This ex-RAF machine (GT-414) was used as an advanced trainer with the Lentosotakoulu and is pictured at Kauhava on 3 March 1943.

Above: The Finns restored three captured Lavochkin LaGG-3s to flying condition. LG-3 of LeLv 32 is seen here being pushed out of a hanger at Nurmoila on 23 March 1943 for its first sortie. Engine and gun problems plagued the aircraft.

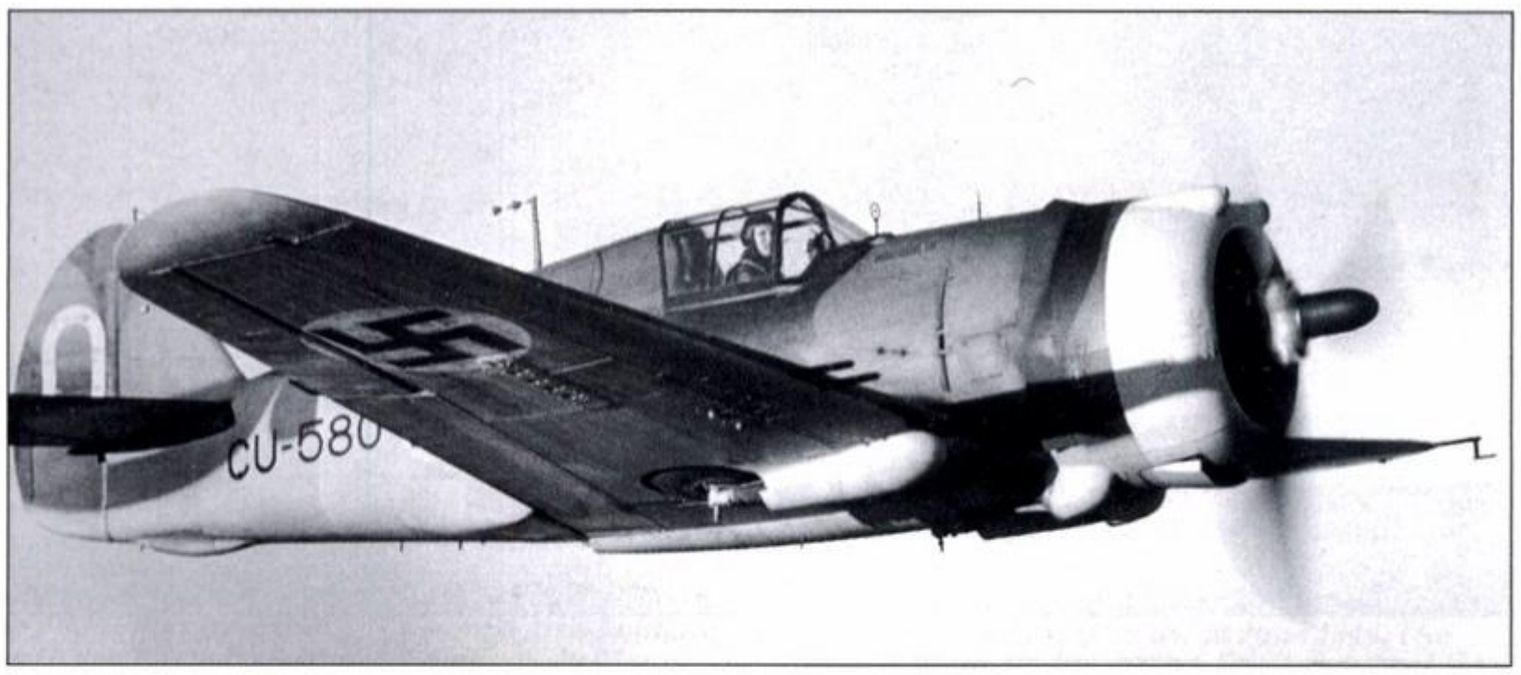
Above: Moranes of Lentolaivue 28 rest on a forward landing strip at Latva by the River Svir in September 1943. Reconnaissance missions were flown from here long distances south of Lake Onega.

Do 17Zs and LeLv 48 was to receive captured DB-3Ms and Pe-2s. The regiments' attacks from then on would utilise almost all the aircraft available and have a fighter escort in daylight. To ascertain the effectiveness of these raids, photo-reconnaissance raids would follow.

Two independent squadrons covered the flanks, Lentolaivue 14 with Fokker D.XXIs and Fokker C.Vs in southern Viena fortified with one flight of Brewsters, and Lentolaivue 6 flying anti-submarine missions over the Gulf of Finland with captured Tupolev SBs.

Over the Gulf of Finland

At the beginning of August 1942, the major part of Lentolaivue 24 (Brewsters) was transferred to the Karelian Isthmus under LeR 3, to meet the growing activity of the Soviet Baltic Fleet air forces. At first the Finns tried to attack the Russians on their way to their targets, but this did not bring results and tactics were changed, so that Russian aircraft were met on their way home – this time with greater success. In fierce air battles over the eastern Gulf of Finland, starting on 12 August, the Russians lost 39 fighters in the space of a week for the price of one Brewster. On 5 September, six Curtiss Hawks of Lentolaivue 32 fought a 40-strong Russian fighter regiment over the River Svir and sent down 13 aircraft of various types, without loss.



A fifth regiment (LeR 5) was established on 5 November for maritime duties with two squadrons. LeLv 6 flew captured Tupolev SB bombers and various obsolete floatplanes, and LeLv 30 operated captured Polikarpov I-153s.

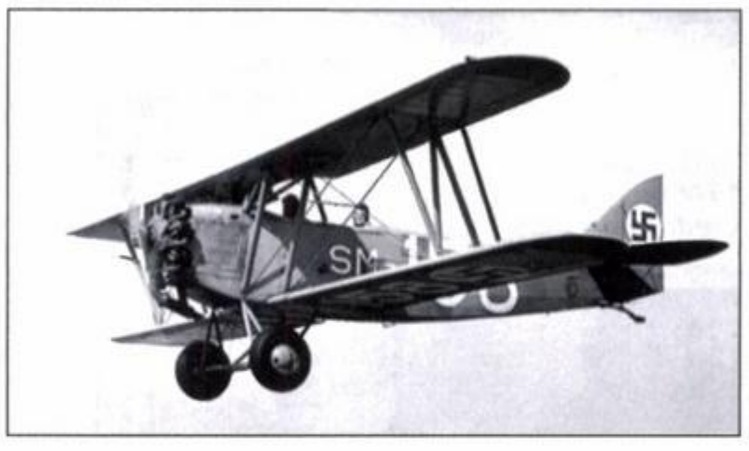
The year ended quietly, the fighters having shot down 355 Soviet machines. Finnish losses on operations amounted to just 34 aircraft, and on 31 December the Finnish air force had 135 aircraft available.

February 1943 brought a serious set-back for the bomber command, when an attempt to bomb Segesha armament and ammunition fac-

Right: Curtiss Hawk 75A-2 CU-580 of Lentolaivue 32 was captured on film escorting a Fokker C.X reconnaissance aircraft from Lentolaivue 12 over the River Svir on 16 October 1943. This aircraft was one of 15 ex-French aircraft supplied from German war booty stocks six months earlier and survived into 1948, when it was damaged beyond economic repair in a landing accident.

Below: Thirty-one examples of the domestically designed and built Tuisku were employed as navigation and air gunnery trainers. A prototype flew in 1933, the type entering service in 1939. TU-167 of the Lentosotakoulu has a rear-mounted gun fitted for the latter role and is seen here over Kauhava in July 1943.

The primary trainer in the Finnish air force during this period was the Czech Letov S.218A Smolik. SM-158 is seen here in July 1943 over Kauhava, where the Lentosotakoulu had been based since 1927.



Fokker C.VD FO-80 of LeLv 14 idles at Tiiksjärvi on 20 June 1943. The unit's 3rd Flight operated this obsolete type on propaganda missions and reconnaissance over the flanks of the Finnish lines in the eastern Karelian wilderness.

1943

23 January Lentolaivue 34 was re-established, now as a fighter squadron in Lentorykmentti 3. The squadron was to receive Messerschmitt Bf 109Gs in six weeks.

20 February Lentolaivue 44 handed over the Blenheims to Lentolaivue 42. The aircrews went to Germany for training and to pick up Junkers Ju 88As.

30 May Lentolaivue 44 was declared operational with the 'big Stuka', as it was called by the crews.

19 June Orders were given to Lentorykmentti 1 and 2 to save fuel. This cut the sorties to a minimum, but on the ground all was very quiet.

15 November Lentolaivue 48 handed over the war booty bombers to Lentolaivue 46 and started conversion to the Blenheim.

29 December Lentolaivue 48 was declared operational with Blenheim bombers, which came from a 30-plane batch built by the factory in the latter half of the year.

Above: Junkers Ju 88A-4 JK-262 of Lentolaivue 44 prepares to lift off from Onttola sometime in June 1943. These bombers were practically new when acquired by the Finnish air force and retained their German camouflage.

Dornier Do 17Z (DN-64) of Lentolaivue 46 rests in the snow-covered forest at Tiiksjärvi in eastern Karelia on 12 January 1943. It flew from there for two weeks on mapping missions behind the Soviet front west of the White Sea.

Above: This Tupolev SB-2M-103 was converted in January 1943 into dual-control USB configuration by adding a second cockpit in the observer's position, forward of the original pilot's station. SB-6 of Täydennyslentolaivue 17 taxis back from a training flight at Luonetjärvi on 28 March 1944.

Brewster BW-373 of Hävittäjälentolaivue 26 undergoes service in the open at Immola during the latter part of June 1944. A massive 478 victories were scored by the type.

This Curtiss P-40M Warhawk was captured intact on 27 December 1943. After repairs, it was delivered to Hävittäjälentolaivue 32 for evaluation and is seen at Mensuvaara in August 1944. As it was thought to be a Kittyhawk, it was given serial letters 'KH', as KH-51.

tories on 19 February saw three out of nine bombers lost on a mission hampered by a snowstorm; another five aircraft were damaged.

Early in 1943 Germany was licking its wounds, having lost two major battles, one in Stalingrad and the other in North Africa. Realising it needed to win as many friends as it could, Germany finally agreed to supply modern military aircraft to the Finns. A new fighter squadron, Lentolaivue 34, was formed in March under LeR 3, equipped with 30 Messerschmitt Bf 109G-2 fighters. April saw the arrival of 24 Junkers Ju 88A-4s for Lentolaivue 44, which passed on its remaining Blenheims to sister squadron Lentolaivue 42.

Russian units were also re-equipping. In the spring, the Soviet Baltic Fleet air forces equipped with a new generation of aircraft, including Yakovlev Yak-7 and Lavochkin La-5 fighters, Ilyushin Il-2 attack aircraft and

Order of Battle, 9 June 1944

UNIT	BASE	AIRCRAFT
Lentorykmentti 1	***Nurmoila***	
TLeLv 12	Nurmoila	4 Fokker D.XXI and 1 C.X
HLeLv 32	Nurmoila	15 Curtiss Hawk and 2 LaGG-3
Lentorykmentti 2	***Petrozavodsk***	
TLeLv 16	Hirvas	5 Gladiator, 4 Lysander and 3 Fokker C.X
HLeLv 28	Hirvas	20 Morane 406
Lentorykmentti 3	***Suulajärvi***	
HLeLv 24	Suulajärvi	14 Bf 109G
HLeLv 26	Heinjoki	18 Brewster and 1 Fokker C.X
HLeLv 34	Kymi	16 Bf 109G
Lentorykmentti 4	***Onttola***	
PLeLv 42	Värtsilä	17 Blenheim
PLeLv 44	Onttola	13 Ju 88A
PLeLv 46	Mensuvaara	8 Do 17Z, 4 DB-3M and 2 Il-4
PLeLv 48	Onttola	19 Blenheim, 4 Pe-2, 2 DB-3M and 1 Do 17Z
Lentorykmentti 5	***Helsinki***	
PLeLv 6	Nummela	14 SB, 3 Høver and 2 Do 22K
HLeLv 30	Helsinki	8 Bf 109G and 2 Fiat G.50
TLeLv 14	Tiiksjärvi	11 Morane 406 and 2 Fokker D.XXI

Petlyakov Pe-2 and Douglas Boston bombers. All were used to attack the supply vessels and ports servicing the mine-belt across the Gulf of

From July 1944 onwards the remaining Morane MS.406s were converted into Mörkö Morane ('Ghost Morane') configuration, with captured 1,100-hp (820-kW) Klimov M-105P engines. MSv-633 was flown to Rissala for service with Hävittäjälentolaivue 21 on 17 March 1945.

Messerschmitt Bf 109G-6 MT-451 of Hävittäjälentolaivue 34 is seen at the edge of Taipalsaari airfield in July 1944. In all, 114 Bf 109G-6s were acquired from Germany from March 1944 onwards. A total of 663 aerial victories was credited to these aircraft.

Above: Pommituslentolaivue 6's Dornier Do 22K-1 DR-195 is in the process of tying up at Maarianhamina after a reconnaissance flight over the Baltic Sea, 22 July 1944.

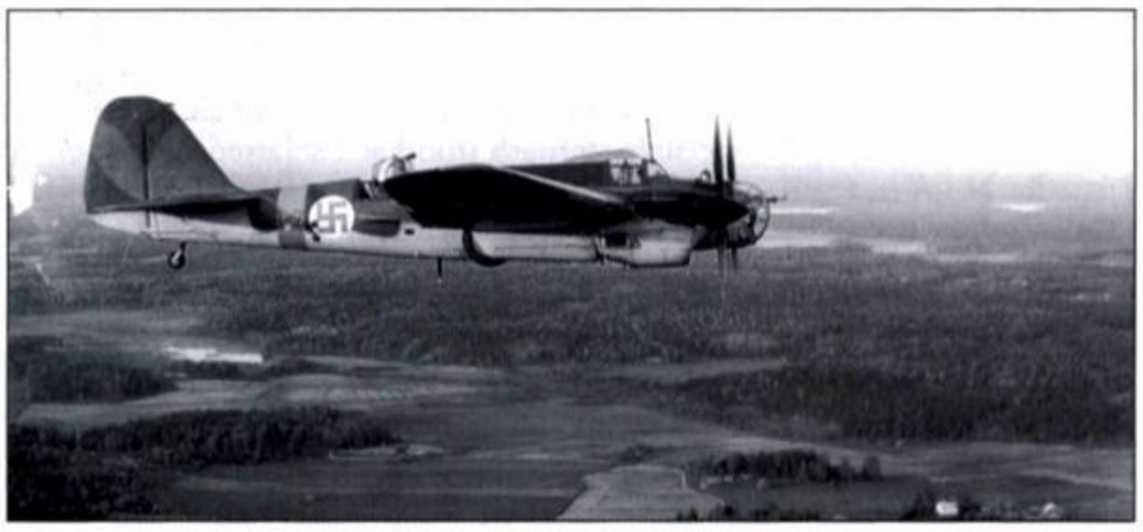
Above: Blenheim Mk I BL-111 of Täydennyslentolaivue 17 lands at Luonetjärvi on 28 March 1944. Previously, the aircraft had seen 18 months continuous service as a bomber with LeLv 44.

Right: Pommituslentolaivue 44 took delivery of Junkers Ju 88A-4 JK-266 after a minor overhaul at Immola on 15 June 1944. Unusually, these aircraft wore a fighter-type tactical number on their tail fins. In all, 24 were obtained from Germany.

Finland, intended to hold back Soviet shipping. Lentolaivue 24 faced the challenge; its obsolete Brewster aircraft flown by experienced pilots once more showed their skill, claiming 19 aircraft shot down on 18 April and another 17 three days later. The scoring continued the following month and in a six-week period the Brewsters had sent down 81 Soviet planes for the loss of two of their own. During the same period the Messerschmitts of Lentolaivue 34 destroyed an additional 46 aircraft in minor skirmishes, making this a very costly period for the Red Banner Baltic Fleet air forces.

After taking breath, the Soviet air forces resumed their raids in August and caused considerable damage to the supply units and strongholds of the mine-belt. In retaliation, the bomber regiment carried out an attack against Lavansaari, a major Russian air base in the Gulf of Finland, on 17 September. Mist and low cloud prevented accurate bombing and on their return in the evening many of the bombers lost their way as the sun set. Two crashed and seven were damaged on landing.

Pommituslentolaivue 6 flew many successful anti-submarine missions with captured Tupolev SB bombers. SB-7 of the unit's 2nd Flight flies over the coast of southern Finland in June 1944. The type was to see Finnish service as late as March 1945.



JK-268 of Pommituslentolaivue 4 accompanies a sister aircraft returning from a dive-bombing sortie on the Karelian Isthmus, 28 June 1944. The Junkers Ju 88 was a first-class bomber, its computing Stuvi sight making accurate attacks possible, even on naval vessels.

1944

14 February All operational squadrons had the 'role letter' added to their number. For example, Lentolaivue 24 became Hävittäjälentolaivue 24 (HLeLv 24). Bomber squadrons became PLeLv and reconnaissance units, TLeLv.

6 March Hävittäjälentolaivue 34 handed over its 2nd Flight to Hävittäjälentolaivue 30 at Helsinki-Malmi, the latter becoming the second squadron equipped with the Bf 109.

9 June The main Soviet offensive was launched on the Karelian Isthmus.

10 June Hävittäjälentolaivue 28 joined Lentorykmentti 3, bringing its fighters to the Karelian Isthmus.

12 July The Soviet attack on the Karelian Isthmus came to a halt, the Finns having gained control of the front.

23 July Hävittäjälentolaivue 28 became part of Lentorykmentti 2, two flights with Bf 109s, the other Mörkö Moranes.

3 August Hävittäjälentolaivue 26 joined Lentorykmentti 2, as the regiment was in need of more fighters.

4 September The Continuation War ends and an armistice is signed. The Soviet Union had failed for a second time to conquer Finland.

15 September Under preliminary truce terms, German personnel were required to leave the country; to this end, military operations against German forces began in the north of the country – the Lapland War had begun.

19 September The final truce with the Soviets was signed in Moscow and the Finns withdrew to the 1940 Moscow peace treaty borders. All flying, except missions against German forces, was made subject to the Allied Supervision Commission approval.

29 September Hävittäjälentolaivue 30, with Bf 109s, joined Lentorykmentti 3.

1 October Pommituslentolaivue 6 became part of Lentorykmentti 4, now a dedicated bomber regiment.

6 October Lentoryhmä (Air Group) Sarko was formed to fight the German forces in northern Finland. It consisted of Lentorykmentti 2 with TLeLv 14, HLeLv 26, 28 and 34 plus (operationally) Lentorykmentti 4 with PLeLv 6, 42, 44, 46 and 48. Total strength was 55 fighters, 39 bombers and three reconnaissance aircraft. All but the 30 Bf 109Gs of Hävittäjälentolaivue 34 participated in the Lapland War.

8 October Lentorykmentti 5 headquarters was disbanded, its squadrons having been transferred to other regiments.

21 October 6 Myrskys of Tiedustelulentolaivue 12 joined Hävittäjälentolaivue 26 and were transferred to Lapland to fly reconnaissance missions.

30 October The Finnish advance in Lapland had reached the 68th parallel, leaving small German outfits in the extreme northern and northwestern tips of Finland.

16 November Lentoryhmä Sarko was disbanded and Lentorykmentti 2 took over aerial operations in Lapland. Lentorykmentti 4 came under Lentorykmentti 2 command for operations.

3 December Lentorykmentti 4 was put in sole command of Lapland operations and absorbed Hävittäjälentolaivue 26 for fighter reconnaissance.

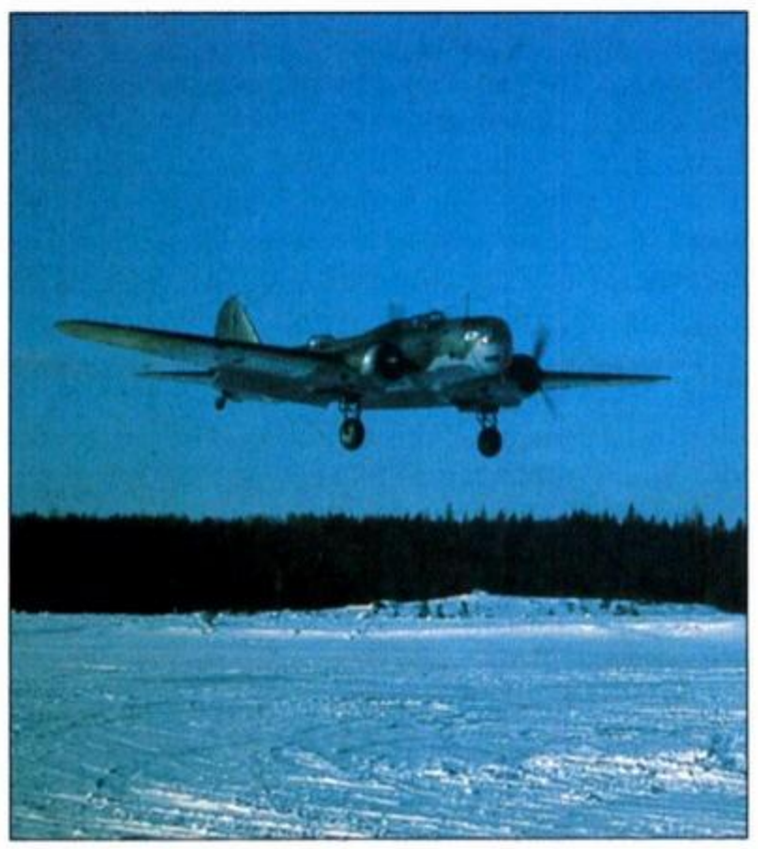
4 December According to the terms of the truce with the Soviet Union, the Finnish armed forces were immobilised and the following squadrons disbanded: PLeLv 6, TLeLv 14, T-LeLv 17, HLeLv 30, HLeLv 32, T-LeLv 35 and PLeLv 48. Others were renumbered as follows:

TLeLv 12	renumbered	HLeLv 11
TLeLv 16	renumbered	HLeLv 13
HLeLv 26	renumbered	HLeLv 21
HLeLv 28	renumbered	HLeLv 23
HLeLv 24	renumbered	HLeLv 31
HLeLv 34	renumbered	HLeLv 33
PLeLv 42	renumbered	PLeLv 41
PLeLv 44	renumbered	PLeLv 43
PLeLv 46	renumbered	PLeLv 45

Left: Ilyushin Il-4 DF-25 of Pommituslentolaivue 46 idles at Luonetjärvi on 28 March 1944. Four of these aircraft were acquired in late 1942 from German depots, though one was destroyed on the delivery flight. The remainder were in service until February 1945; DF-25 was wrecked in an accident the previous month.

Below left: Bristol Blenheim Mk II BL-179 of Täydennyslentolaivue 17 is seen here under tow by a tracked tug, in the snow at Luonetjärvi on 28 March 1944. This unit was tasked with advanced training in bomber regiment Lentorykmentti 4.

Below: Ilyushin DB-3M DB-17 of Pommituslentolaivue 46, which operated the type during 1943/44, lands at Luonetjärvi on 28 March 1944. This captured Soviet machine remained in service until September 1945. In all, 11 DB-3Ms served with the Finnish air force.



On 23 September 1943 four Brewsters and four Messerschmitts fought over the eastern Gulf of Finland against a 20-ship formation of Soviet fighters returning from a mission to the German front. They shot down 15 aircraft, without loss.

The latter half of 1943 also saw the State Aircraft Factory turn out more aircraft; 30 new Blenheim Mk IIs were completed, these equipping Lentolaivue 48. At last, the bomber regiment was up to its planned establishment of four squadrons.

In 1943 the Finns had sent down 307 Russian aircraft and lost 35 machines on operations. At the end of the year, the air force's serviceable strength stood at 188 aircraft.

At the end of January 1944 the Russians broke the siege of Leningrad and the military and political situation changed overnight. In an attempt to persuade the Finns to stop fighting, the Soviet long-range bomber force attacked Helsinki, the Finnish capital, on three occasions during the nights of 5/6, 15/16 and 25/26 February. To counter these attacks, Finnish bombers targeted the Russian bomber streams returning from their missions. While the Soviets landed on well-lit airfields, the Finns had no problem in placing their bombs. Especially destructive was the late evening attack on 9 March, when the long-range bombers returned from a mission over Tallinn, Estonia. The bombs of 21 Finnish aircraft fell on four airfields. At least 10 enemy bombers were set on fire, with many others damaged and fuel reserves destroyed.

During March 1944 Hävittäjälentolaivue 30 was modernised and received new Messerschmitt Bf 109G-6 fighters. Their assigned task was interception over southern Finland and the central Gulf of Finland.

Meanwhile, a rejuvenated Finnish bomber force was beginning to establish itself. On the evening of 3 April, 34 bombers attacked Kähy airfield near Leningrad and destroyed 17 of the

Left: Prompted by the arrival of modern Russian aircraft like the La-5, VL set about designing a new fighter, using locally available wood in its construction. The Pyörremyrsky (Whirlwind) was the result, powered by a Daimler-Benz DB 605 and featuring wooden wings and a wooden rear fuselage monocoque. The air force ordered two in 1942, cancelling one in 1944. Coded PM-1, the sole prototype was first flown in 1944 and tested between 1945 and 1947. It proved to be highly manoeuvrable, with an excellent climb rate.

Hävittäjälentolaivue 24 converted from Brewsters to Messerschmitt Bf 109Gs in spring 1944. The pilot of MT-213 throttles up his aircraft's DB 605 engine for take-off from Suulajärvi on the Karelian Isthmus, 12 May 1944.

Fokker C.Xs were reduced to target-towing duties after the war. FK-114 (one of the last batch of five delivered in 1942) of Hävittäjälentolaivue 21 is seen here on its way to a gunnery range in March 1946. C.Xs served until 1958.

57 aircraft on the ground. During April, Hävittäjälentolaivue 24 stationed on the Karelian Isthmus handed over its Brewsters to Hävittäjälentolaivue 26 and converted to the Messerschmitt Bf 109G.

A Soviet formation of 27 bombers escorted by 15 fighters arrived on 17 May 1944 to bomb Kotka, the northern supply point of the mine-belt. Eleven Bf 109s of Hävittäjälentolaivue 34 scrambled and attacked from below, shooting down eight bombers and three fighters in exchange for one of their number.

Soviet summer offensive

On 9 June the Soviet Union launched its fourth strategic blow on the Karelian Isthmus with 15 divisions of infantry supported by 1,550 aircraft. To repel this, the Finns had two divisions available, supported by 30 fighters from LeR 3 and 60 bombers from LeR 4. The overwhelming size of the Russian advance forced the Finns to retreat to a line level with Viipuri. Here, they managed to halt the onslaught, helped in no small part by the Soviet command, which stopped their attack on 12 July and transferred troops to the German front for the 'race to Berlin'. The Finnish air force was flying numerous sorties every day, as well as during the light Nordic nights, often engaging Soviet formations of over 200 aircraft. The fighters scored several hundred kills, while the bomber regiment wreaked havoc in the densely packed Soviet troop, tank and artillery formations.

During the concentrated attacks on the Karelian Isthmus, typical Finnish bomber formations numbered 35 aircraft, usually with an escort of 16 Messerschmitts. The latter protected the bombers so effectively that not a single one was lost to Russian fighters. After requests from Finland for assistance, Germany sent Gefechtsverband Kuhlmey to Finland on 16 June from the Baltic front. This consisted of 30 Focke-Wulf Fw 190A-6 fighters and Fw 190F-8 fighter-bombers plus 25 Junkers Ju 87D-5 dive-bombers, which did a remarkable job in precision bombing. In addition, 80 new Bf 109G-6s were flown in for Finnish fighter units. The offensive on the Karelian Isthmus lasted 38 days. LeR 4's bombers flew 1,232 sorties on 36 missions, while the fighters

The last Westland Lysander in the Finnish Air Force inventory was LY-115, one of the batch of partly disassembled Lysanders delivered for assembly in Sweden in 1940. It is seen here at Kauhava in October 1945 while with Hävittäjälentolaivue 21. The following month it was flown for the last time and by March 1946 had been written off.

Below: Bf 109G-2 MT-207 was attached to Hävittäjälentolaivue 11 at Pori in September 1946. The following month the fighter was written off in a landing accident. The tropical filter on the aircraft's engine air intake was fitted in Finland to combat dust problems on the air force's largely unpaved airfield runways.

Fokker D.XXI FR-123, an airframe credited with 3.25 victories during the war, was on charge with the Lentosotakoulu at Kauhava in April 1946. The State Aircraft Factory (VL) constructed 50 in 1941 and another five in 1944. All were powered by Twin Wasp Junior engines, as Bristol Mercuries were required for Blenheim production.

Curtiss Hawk 75A (CU-502) of Hävittäjälentolaivue 13 test runs its engine at Pori in September 1946. Originally this machine was a Hawk 75A-4 variant, fitted with a troublesome Cyclone engine, but was re-engined with a Twin Wasp in July 1943.

1945

20 January Only Pommituslentolaivue 43 (ex-PLeLv 44) continued flying in Lapland. All other units were transferred to peacetime bases.

27 March The last few remaining German units in Lapland withdrew to Norway, and Finland ceased being in a state of war.

1 April The traditional blue and white swastika insignia (in use since 6 March 1918) was changed to a blue-white roundel. This was demanded by the Allied Supervision Commission headed by Russians.

4 April The last sorties against the Germans were flown by the Finnish Air Force.

1 August The flying ban was cancelled and peacetime training programmes commenced.

1947

10 February The Paris peace treaty confirmed the 4 September 1944 truce with Soviet Union. The Finnish Air Force combat aircraft strength was cut to 60 in number, which was not to include bombers.

29 September Wartime camouflage was officially discontinued. Finnish Air Force camouflage had been used on most combat aircraft during the previous seven years.

1948

15 September All remaining bombers and fighters, except the Messerschmitt Bf 109Gs, were stored and later scrapped.

1949

28 March Valmet (ex-State Aircraft Factory) received an order for one advanced trainer prototype named Vihuri, the first acquisition effort since the war.

A Decade of Air Power

Right: A Focke-Wulf Fw 44J Stieglitz (SZ-33) primary trainer of Hävittäjälentolaivue 33 cruises over southern Finland in the summer of 1949. Thirty were obtained from Germany in 1940, another five following four years later. The type served until 1962.

Below: During the first half of 1944, 10 Blenheim Mk IVs were assembled locally, mostly from Yugoslavian Ikarus components. BL-205 was one of these aircraft and is seen here while with Pommituslentolaivue 45. The aircraft had been converted for mapping duties and is parked at Luonetjärvi, July 1947.

Left: The VL Myrsky II was the only Finnish-designed wartime fighter to see series production, a total of 51 being assembled. MY-44 (the 40th Myrsky II built) of Hävittäjälentolaivue 13 is readied for a sortie from Pori on the Finnish west coast, sometime in September 1946. Built in 1944, the Myrsky IIs were too late to see service against Soviet forces.

Order of Battle, 1 January 1945

UNIT	BASE	AIRCRAFT
Lentorykmentti 1	***Pori***	
HLeLv 11	Kemi*	6 Myrsky
	Pori	18 Myrsky and 7 Curtiss Hawk
HLeLv 13	Pori	10 Myrsky, 7 Curtiss Hawk and 1 Warhawk
Lentorykmentti 2	***Rissala***	
HLeLv 21	Rissala	16 Morane 406, 2 Fokker C.X and 1 Lysander
HLeLv 23	Kemi*	6 Brewster
	Rissala	11 Bf 109G, 5 Fokker D.XXI and 8 I-153
Lentorykmentti 3	***Utti***	
HLeLv 31	Utti	38 Bf 109G
HLeLv 33	Utti	38 Bf 109G
Lentorykmentti 4	***Luonetjärvi***	
PLeLv 41	Kemi*	15 Blenheim
	Luonetjärvi	12 Blenheim
PLeLv 43	Kemi*	9 Ju 88A, 4 Do 17Z and 1 Do 22K
PLeLv 45	Kemi*	4 DB-3M and 2 Il-4
	Luonetjärvi	9 SB
	Turku**	5 SB

* *Deployed against German forces in Lapland*
** *Flying anti-submarine patrols over the Baltic Sea*

of LeR 3 completed another 2,168 sorties on 355 missions.

A secondary front on the Olonets Isthmus was opened by the Red army on 20 June, but this had also been repelled by mid-July. By early August all fronts had ground to a standstill. Both parties could now negotiate a separate peace. A ceasefire was accordingly declared on 4 September and a formal truce followed two weeks later. During 1944, Finnish fighters had shot down 578 Soviet aircraft for the operational loss of 73 machines. In all, 198 aircraft were serviceable at the end of hostilities.

In two wars of fighting against the Soviet Union, Finland had fought back and preserved its independence. Finnish forces had destroyed 3,313 Soviet aircraft, 1,807 of which fell to Finnish aircraft and 1,345 to ground-based anti-aircraft fire, the balance being made up of those shot down by naval units, destroyed on the ground or seen to crash in unknown circumstances. Finnish losses amounted to 257 aircraft lost on operations, 215 lost on non-operational flights and 100 destroyed in training accidents. In all, 353 airmen were killed or posted missing in action and another 86 lost in flying accidents.

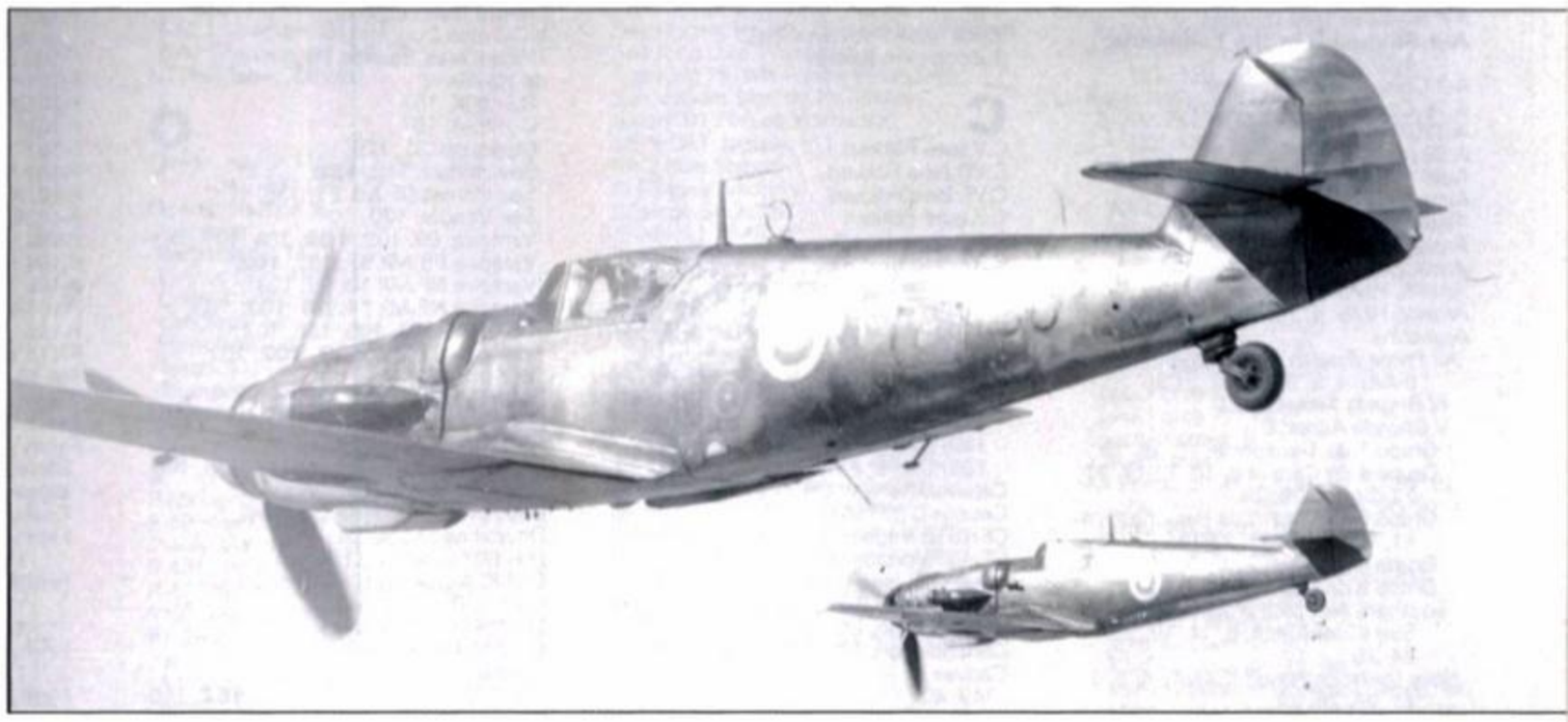
The Lapland War

To comply with the terms of its truce with the Soviet Union, German forces needed to be driven out of the country. War was declared on 15 September, battle commencing on 1 October when Finnish forces made a seaborne landing in the north at Tornio, to the rear of the German forces. Simultaneously, the Soviets attacked on the Arctic Sea coast and occupied all northern Luftwaffe units there.

By the end of October 1944 the Germans had been driven to the extreme north, but by

By November 1945 a total of 41 Mörkö Morane conversions had been made by the aircraft factory. MSv-651 and 318 of Hävittäjälentolaivue 21 are paying a visit to Luonetjärvi in July 1946. A Mauser MG 151 fired through the propeller hub; wing guns were the original 7.5-mm MAC 1934s.

Right: This row of Messerschmitt Bf 109G-6s of Hävittäjälentolaivue 31 was photographed at Utti during August 1953. Nearest the camera is MT-503. All still retain 1944-vintage Luftwaffe camouflage.



Right: Bf 109G-6s serialled MT-435 and MT-494 of Luonetjärvi-based Pommituslentolaivue 41 patrol over central Finland in the summer of 1952. The former still wears its original camouflage scheme applied some eight years earlier.

then winter weather prevented major operations. In practical terms, the war was over. The last German forces withdrew to northern Norway on 27 March 1945, ending hostilities.

During this final phase, accurate German anti-aircraft fire took a toll of 11 aircraft. Under the primitive conditions and adverse Arctic winter weather the Finnish air force suffered the loss of another six aircraft. As German aircraft were rarely encountered in this last months, the Finnish fighter force made only three kills.

Peace

An Allied Supervision Commission arrived just after the 19 September 1944 truce, headed by Russian officers with observers from other Allied countries. Their task was to see that Finland complied with the truce terms. Members of the Commission enjoyed full diplomatic rights and theoretically free access to air bases. The Commission's first decision was to issue a total flying ban, except where sorties were carried out against German targets. All other flying was subject to Commission approval; air force headquarters was reduced to little more than administrative duties. This restriction was enforced until 1 August 1945.

The peace treaty ending World War II in Europe was confirmed in Paris on 10 February 1947 and ratified by the Finnish parliament on 15 September. Within 11 days, the Allied Supervision Commission had been disbanded.

The remainder of the 1940s was marked by the mass grounding of many aircraft types, including all bombers, as a stipulation of peace treaty terms. By 15 September 1948 HLeLv 23, PLeLv 43 and 45 had been disbanded, remaining squadrons gradually re-equipping with the Messerschmitt Bf 109Gs. These were to be the Finnish air force's main front-line equipment into the next decade. **Kari Stenman**

Right: Lentosotakoulu Stieglitz and Viima aircraft displayed at Utti in summer 1953. The VL Viima closely resembled the Fw 44, but was in fact an entirely local design. (The Stieglitz was distinguished by the pronounced dihedral in the upper wing surface.) Twenty-three were built in the latter part of 1939. The four machines shown here are, from left, SZ-22, SZ-30, VI-22 and SZ-7.

Finnish air force types, 1940-1949

Code	No.	Serials allocated	Type
AEj	16	49-64	Aero A-32GR
AN	3	101-102	Avro Anson I
AV	2	186, 187	Shavrov Sh-2
BC	2	1-2	Beechcraft C 17L and D 17S
BL	97	104-190, 195-205	Bristol Blenheim Mks I, II and IV
BU	19	59-75, 214, 216	Bristol Bulldog Mks IVA and IIA
BW	44	351-394	Brewster Model 239
CA	6	551-556	Caudron C.R. 714
CE	1	1	Cessna C-37
CU	44	501-501, 551-587	Curtiss Hawk 75A
DB	11	11-21	Ilyushin DB-3M
DF	4	22-25	Ilyushin Il-4
DN	15	51-65	Dornier Do 17Z
DO	3	1-3	Douglas DC-2
DR	4	195-198	Dornier Do 22Kl
DS	1	1	Desoutter Mk II
EV	1	1	Airspeed A.S.6
FA	35	1-35	Fiat G.50
FD	1	1	Fairchild 24J
FE	2	1-2	Fokker F.VIII and VIIa
FK	39	78-111, 111-115	Fokker C.X
FO	19	39, 65-77, 65-66, 19, 23, 80	Fokker C.VE and D
FR	97	76-167, 171-175	Fokker D.XXI
GL	30	251-280	Gloster Gladiator Mk II
GT	24	395-418	Gloster Gauntlet Mk II
HC	13	451-462, 465	Hawker Hurricane Mks I and IIA
HE	1	115	Heinkel He 115A
HL	2	59-60	Heinkel He 59C
HT	3	191-193	Hanriot H.232
HM	1	671	VL Humu
IH	5	1-5	Polikarpov I-15bis
IR	2	21, 101	Polikarpov I-16
IT	22	11-31	Polikarpov I-153
JF	3	219, 224, 228	ASJA J6A and B Jaktfalken
JK	24	251-274	Junkers Ju 88A-4
JU	13	120, 122-128, 131-135	Junkers F.13, K.43 and W.34
KA	6	144-149	VL Kotka I and II
KH	1	51	Curtiss P-40M Warhawk
KO	2	129-130	Koolhoven F.K.52
LG	3	1-3	Lavochkin LaGG-3
LY	12	114-125	Westland Lysander Mk I
MO	23	93-94, 96-104, 106-116, 159	de Havilland DH 60X and 82A
MT	162	201-248, 401-514	Messerschmitt Bf 109G-2/G-6
MS	87	301-330, 601-657	Morane-Saulnier MS.406 and MS.410
MSv	41	various*	Morane-Saulnier Mörkö Morane
MY	51	1-51	VL Myrsky I and II
NK	3	171-173	Høver MF.11
PE	8	211-217, 301	Petlyakov Pe-2/Pe-3
PM	1	1	VL Pyörremyrsky
PY	41	1-41	VL Pyry
RI	25	121, 129-143, 150-159	Blackburn Ripon Mk IIF
SB	24	1-24	Tupolev SB
SK	1	1	Junkers A.50
SM	39	127-165	Letov S 218A
ST	2	112-113	Fieseler Fi 156K
SZ	35	1-35	Focke-Wulf Fw 44J
SÄ	33	95, 113, 117-148	VL Sääski I, II and IIA
TU	31	149-179	VL Tuisku
UT	1	1	Polikarpov I-16UTI
VI	24	1-23, 40	VL Viima I and II
VU	4	2, 2-4	Polikarpov U-2
VV	5	181-185	Beriev MBR-2

* Klimov-engined Mörkö Morane were MSv-302/10/3/5/6/8/9/21/6/8/602/4/5/13/15-7/9/22-6/9-33/6/9-42/6/9-53/6/7

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F-4E Phantom (see McDonnell Douglas)
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Fairey Firefly variants

Finnish air force, 1940-49

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